ABAMECTIN (177)

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BACKGROUND INFORMATION

Abamectin belongs to the family of avermectins, which are macrocyclic lactones produced by a soil actinomycete, *Streptomyces avermitilis*. It is a broad-spectrum acaricide with additional insecticidal action on a limited number of insects. The compound acts on insects by increasing the membrane permeability to chloride ions, and it mainly stimulates the release of γ-aminobutyric acid (GABA). The affected arthropod becomes paralysed, stops feeding, and dies after a few days. It exerts contact and stomach action, with limited plant systemic activity, but exhibits translaminar movement into treated leaves. Abamectin is also used as an anthelmintic drug in veterinary medicine.

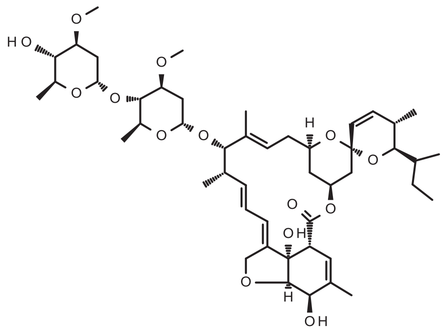
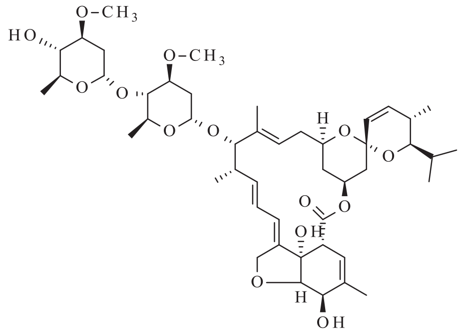
Abamectin was firstly evaluated by JMPR in 1992 (T,R). The latest review of toxicology data was conducted in 1997 and of residue data in 2000. Abamectin was scheduled at the 46th Session of the CCPR (2014) for the periodic re-evaluation of toxicology and residues by the 2015 JMPR.

For the residue evaluation, data were submitted on physical chemical properties, environmental fate, metabolism on plants and lactating goats, analytical methods, GAP, supervised trials on fruits, vegetables, nuts, beans, coffee, cotton and cereals, processing studies and a cow feeding study.

IDENTITY

Abamectin is a mixture containing ≥ 80% avermectin B_{1a} and ≤ 20% avermectin B_{1b}. The absolute stereochemistry of both avermectin homologues is known and defined at each chiral centre and stereogenic carbon-carbon double bond by their IUPAC nomenclature.

ISO Common Name:	Abamectin
Composition:	a mixture containing ≥ 80% avermectin B_{1a} and ≤ 20% avermectin B_{1b}
IUPAC nomenclature:	
Avermectin B_{1a}:	(10*E*,14*E*,16*E*)-(1*R*,4*S*,5′*S*,6*S*,6′*R*,8*R*,12*S*,13*S*,20*R*,21*R*,24*S*)-6′-[(*S*)-*sec*-butyl]-21,24-dihydroxy-5′,11,13,22-tetramethyl-2-oxo-(3,7,19-trioxatetracyclo [15.6.1.1^{4,8}.0^{20,24}]pentacosa-10,14,16,22-tetraene)-6-spiro-2′-(5′,6′-dihydro-2′*H*-pyran)-12-yl 2,6-dideoxy-4-*O*-(2,6-dideoxy-3-*O*-methyl-α-L-*arabino*-hexopyranosyl)-3-*O*-methyl-α-L-*arabino*-hexopyranoside
Avermectin B_{1b}:	(10*E*,14*E*,16*E*)-(1*R*,4*S*,5′*S*,6*S*,6′*R*,8*R*,12*S*,13*S*,20*R*,21*R*,24*S*)-21,24-dihydroxy-6′-isopropyl-5′,11,13,22-tetramethyl-2-oxo-(3,7,19-trioxatetracyclo[15.6.1.1^{4,8}.0^{20,24}] pentacosa-10,14,16,22-tetraene)-6-spiro-2′-(5′,6′-dihydro-2′*H*-pyran)-12-yl 2,6-dideoxy-4-*O*-(2,6-dideoxy-3-*O*-methyl-α-L-*arabino*-hexopyranosyl)-3-*O*-methyl-α-L-*arabino*-hexopyranoside
CA nomenclature:	
Abamectin:	Avermectin B_1
Avermectin B_{1a}:	5-O-demethyl-avermectin A_{1a}
Avermectin B_{1b}:	5-O-demethyl-25-de(1-methylpropyl)-25-(1-methylethyl)-avermectin A_{1a}
CAS registry no:	
Abamectin:	71751-41-2
Avermectin B_{1a}:	65195-55-3
Avermectin B_{1b}:	65195-56-4

CIPAC no:	495	
Chemical structures		
:	 Avermectin B_{1a} : $C_{48}H_{72}O_{14}$; mm: 873.1	 Avermectin B_{1b}: $C_{47}H_{70}O_{14}$; mm= 859.1

Physical and chemical properties

Abamectin technical material was of high purity (> 98%) and was used for the determination of the physical and chemical properties of the pure active substance.

Properties of abamectin (> 98% purity) and degradation in water (avermectin B_{1a})

Property	Results	Reference; Report
Appearance(physical state, colour, odour)	White powder, odour was not determined	Das, R 1999
Vapour pressure	< 3.7×10^{-6} Pa at 25 °C was calculated using the LOQ of the test substance	Widmer, H 1999;1999a
Melting point	Melting range: 161.8 °C–169.4 °C, with thermal decomposition during melting	Das, R 1999;
Partition coefficient n-octanol/water	Average log K_{OW} was 4.4 ± 0.3	McCauley, JA 1996
Solubility in water	1.21 ± 0.15 mg/L (pH = 7.57 ± 0.23) at 25 ºC	McCauley, JA 1997
Solubility in organic solvents	At 25 ºC: acetone: 72 g/L dichloromethane: 470 g/L ethyl acetate: 160 g/L hexane: 0.11 g/L methanol: 13 g/L octanol: 83 g/L toluene: 23 g/L	Stulz, J 1999
Density	Density 1.18×10^3 kg/m^3, corresponding to a relative density of 1.18. At 22 ºC.	Füldner, HH 1999
Hydrolysis in water	No hydrolysis at pH 4–9, 25 °C	Maynard, S, Ku, CC 1982;

Property	Results	Reference; Report
[^{3}H] avermectin B_{1a}	No hydrolysis at pH 4–7, 50 °C pH 9, 60 °C: 4.9 d pH 9, 50 °C: 9.9 d pH 9, 25 °C: 213 d (extrapolated) pH 9, 20 °C: 380 d (calculated with Arrhenius equation) Metabolites: 2-epi-avermectin B_{1a}: 25% of AR at 50 and 60 °C 1,18 hydrolysed avermectin B_{1a}: 17.5% of AR at 60 °C unknown: 15.6% of AR at 60 °C	Ellgehausen, H 2001
Photochemical stability in water [23–^{14}C] avermectin B_{1a}	Xenon lamp. DT_{50}: 2 d (equivalent to 1.5 sunlight days at 30–50 °N, pH 7) Metabolites: 8α-oxo-avermectin B_{1a}: 5.6% of AR [8,9-Z]-avermectin B_{1a}: 8.2% of AR, DT_{50},photo 5.8 sunlight days at 30–50 °N	Adam, D 2001
Dissociation constant	No dissociation or spectral changes were observed in the 1–12 pH range at 20 ºC	Hörmann, A 1999

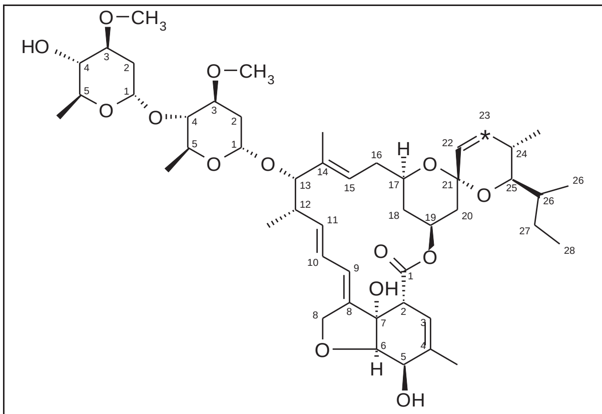
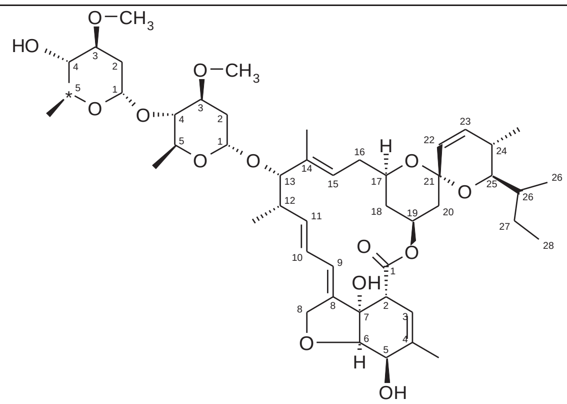
The abamectin technical material of a purity of 96.7% was used for colour, physical state, vapour pressure, melting point, octanol/water partition coefficient, solubility in organic solvents, density, dissociation constant and thermal stability studies. The radio-labelled avermectin B_{1a} used for hydrolysis in water and photochemical stability in water had a radiochemical purity of ≥ 95.6%. The abamectin technical material used for aqueous solubility determination was of unknown purity.

Technical grade material.

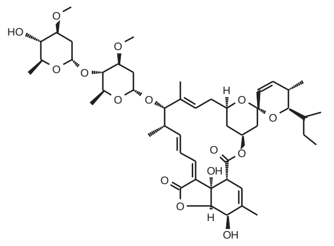
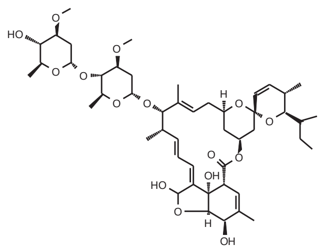
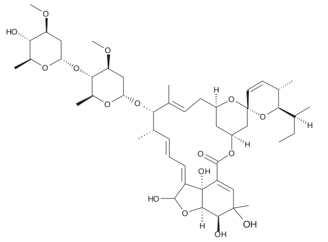
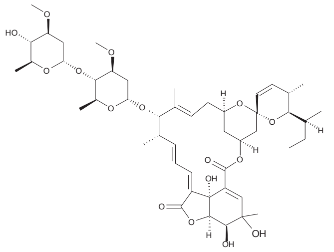
Property	Results	Reference
Minimum purity	Min. 850 g/kg	EC COMMISSION DIRECTIVE 2008/107/EC
Melting Range	Melting range: 161.8 °C–169.4 °C, with thermal decomposition during melting	Das, R 1999; 1999a
Stability (thermal)	Decomposition starts at about 162 °C (see also 'melting range')	Das, R 1999; 1999a

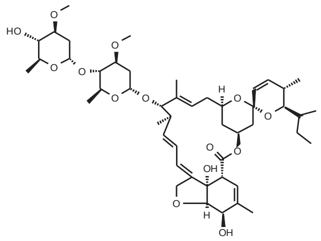
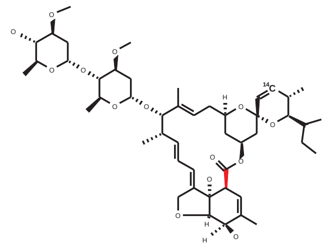
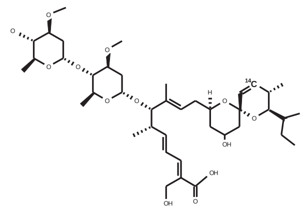
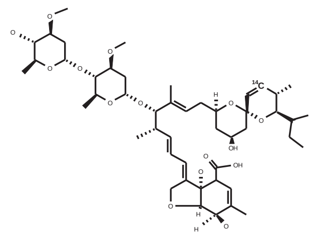
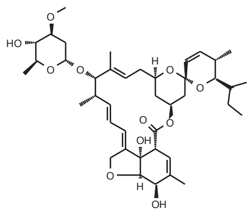
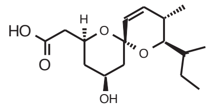
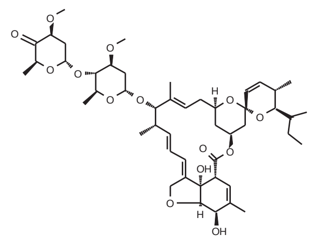
ENVIRONMENTAL FATE AND METABOLISM

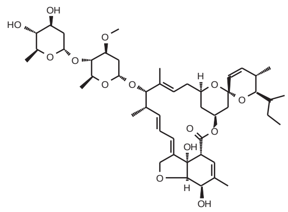
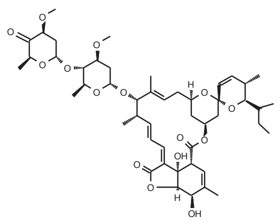
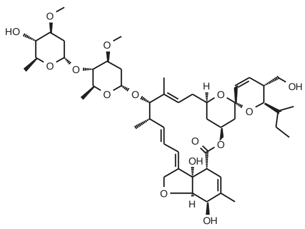
The fate and behaviour of abamectin in soils, water, plants and animals were investigated using [^{14}C] and/or [^{3}H] labelled avermectin B_{1a}.

	
[^{14}C] avermectin B_{1a}: mixture of five single ^{14}C-labelled compounds at C3, C7, C11, C13, and C23 of the main complex. A radioactive label only at the C23 position was also used in some studies ([23-^{14}C])	[^{3}H] avermectin B_{1a}: labelled at C5 of the main complex
Used on studies with soil, citrus, cotton and celery, tomato	Used on studies with soil, celery and lactating goat

The chemical structures of the major degradation compounds arising from the environmental fate and metabolism studies are shown below.

Name	Structure	Compound found in
8α-oxo-avermectin B_{1a}		Aerobic soil Tomato Rat
8α-hydroxy-avermectin B_{1a}		Aerobic soil Celery Tomato Rat
4,8α-dihydroxy-avermectin B_{1a} (also 4,8α-dihydroxy-$\Delta^{2,3}$-avermectin B_{1a})		Aerobic soil
8α-oxo-4-hydroxy-avermectin B_{1a} (also 8α-oxo-4-hydroxy-$\Delta^{2,3}$-avermectin B_{1a})		Aerobic soil

Name	Structure	Compound found in
8,9-Z isomer of avermectin B$_{1a}$		Soil photolysis Citrus Cotton Celery Tomato
2-Epi-avermectin B$_{1a}$		Hydrolysis product at pH 9
DT3		Hydrolysis product at pH 9
1,18-hydrolysed avermectin B$_{1a}$		Hydrolysis product at pH 9
Monosaccharide of avermectin B$_{1a}$ or 4'-O-de(2,6-dideoxy-3-O-methyl-α-L-arabino-hexopyranosyl)-5-O-demethyl-avermectin A$_{1a}$ (Unknown 1)		High temperature hydrolysis
((2S,4S,6S,8R,9S)-8-sec-Butyl-4-hydroxy-9-methyl-1,7-dioxa-spiro[5.5]undec-10-en-2-yl)-acetic acid (I_4)		Tomato
4"-oxo-avermectin B$_{1a}$		Tomato

Name	Structure	Compound found in
3"-O-desmethyl-avermectin B_{1a}		Tomato Goat, Rat
4"-,8α-di-oxo-avermectin B_{1a} (I_{37})		Tomato
(24-hydroxymethyl) avermectin B_{1a}		Goat, Rat

ENVIRONMENTAL FATE

Aerobic degradation in soil

The degradation of [^{14}C]avermectin B_{1a} was investigated in the laboratory under aerobic conditions in one soil (Gartenacker loam) incubated at 20 °C (Nicollier, 2001). The test substance was applied to the soil at a rate of 0.22 mg/kg, equivalent to a field rate of 0.28 kg ai/ha assuming a soil density of 1.3 g/cm^3 and uniform distribution in the upper 10 cm soil layer. Aerobic samples were incubated over 365 days with a soil moisture content of 40% of the maximum water holding capacity. Sampling intervals were immediately after application (0 days) up to 365 days. Samples were submitted to exhaustive extraction and the extracts were analysed by two dimensional TLC and by HPLC. The identity of the soil metabolites was determined by liquid chromatography/mass spectrometry (LC/MS) and nuclear magnetic resonance spectroscopy (NMR). The extracted radioactivity declined from 97.9% at day 0 to 30.6% of the applied radioactivity (AR) at the end of the study (Table 1). Non-extracted residues increased during the study and reached 33.9% AR at Day 365. Non-extracted residues from Day 168 sample were submitted to reflux under neutral and acidic conditions, releasing 5.7% AR. Fractionation of non-extracted residues showed 6–10% AR associated with the fulvic, humin and humic acid fractions. Organic volatiles were ≤ 0.1% AR. The amount of avermectin B_{1a} declined from 97.9% at Day 0 to 1.4% AR at Day 365. 8α-oxo-avermectin $B_{1a}$and 8α-hydroxy avermectin B_{1a} reached a maximum at Day 28. Two minor metabolites were identified as 4,8α-dihydroxy-avermectin B_{1a} and 8α-oxo-4-hydroxy-avermectin B_{1a} amounting at maximum to 9.3% AR. All other metabolites individually represented ≤ 4.1% AR.

Table 1 Distribution of degradation products of avermectin B_{1a} under aerobic conditions (%AR)

Incubation Time	Extracted residues	$^{14}CO_2$	Non-extracted residues	Avermectin B_{1a}	8α-oxo-avermectin B_{1a}	8α-hydroxy avermectin B_{1a}	4,8α-dihydroxy-avermectin B_{1a}	8α-oxo-4-hydroxyavermectin B_{1a}	Recovery
0	97.9	n.d.	0.7	97.9	n.d.	n.d.	n.d.	n.d.	98.6
3	98.6	0.1	2.5	86.8	3.1	5.5	0.2	n.d.	101.2
7	94.9	0.3	5.2	68.2	6.4	9.0	0.9	0.5	100.4
14	90.5	0.8	8.5	51.9	7.5	13.2	2.6	1.3	99.8
28	84.0	1.8	13.6	33.2	10.3	15.7	5.5	3.1	99.5
56	71.0	4.9	21.0	16.7	9.1	13.9	8.9	5.1	96.8
90	63.4	7.8	25.3	9.2	8.0	8.8	9.3	7.8	96.4
120	55.2	11.8	29.0	5.7	4.8	5.2	9.0	8.2	96.0
168	49.8	14.8	29.7	4.5	3.4	3.4	8.2	8.5	94.4
240	39.4	23.6	33.6	3.5	4.1	1.1	5.2	8.3	96.6
294	34.7	23.5	32.3	2.3	1.3	0.9	4.5	7.1	90.6
365	30.6	27.6	33.9	1.4	0.9	0.7	3.8	6.5	92.1

n.d. = Not detected

Avermectin B_{1a} was rapidly degraded under aerobic conditions with a half-life of 18 days. Avermectin B_{1a} was either hydroxylated to 8α-hydroxy avermectin B_{1a} or oxidised to 8α-oxo avermectin B_{1a}. Both of these major metabolites were further hydroxylated with half-lives of 35.4 and 32.5 days, respectively. The endpoint of the metabolic pathway under aerobic conditions was mineralisation to carbon dioxide accounting for up to 27.6% AR, accompanied by the formation of unextracted residues. Table 2 summarizes the half-lives and DT_{90} values for avermectin $B_{1a}$and metabolites.

Table 2 Half-lives and DT_{90} values for avermectin B_{1a} and soil metabolites under aerobic conditions (Nicollier, 2001)

Compound	DT_{50}(days)	DT_{90}(days)
avermectin B_{1a}	18.0	59.6
8α-oxo-avermectin B_{1a}	32.5	108.0
8α-hydroxy-avermectin B_{1a}	35.4	117.8
4,8α-dihydroxy-avermectin B_{1a}	105.2	349.4
8α-oxo-4-hydroxy-avermectin B_{1a}	83.3	276.8

The degradation of [23-^{14}C]-labelled avermectin B_{1a} was investigated in Gartenacker soil (loam/silt loam) under various conditions (Adam, 2001a). Soil samples were treated with avermectin B_{1a} at 0.1 mg/kg dry soil, corresponding to a field rate of 100 g ai/ha. Samples were incubated under aerobic conditions in the dark at a temperature of 30, 20 and 10 °C with a soil moisture content of 40% water holding capacity (WHC; Series 1, Series 2 and Series 3, respectively). In addition, one experiment was performed at 30 °C and 25% WHC (Series 4). Duplicate samples were taken for analysis at each sampling time and submitted to exhaustive extractions before analysis by TLC and HPLC.

The distribution of radioactivity and metabolites at different sampling dates are summarized in Table 3. The extracted radioactivity declined from the beginning to the end of the study, followed by an increase in the non-extracted residues. When non-extracted residues of Day 120 samples were submitted to reflux under neutral and acidic conditions, 4 to 6% AR were released for series 1, 2, 3 and 4, respectively. Subsequent fractionation of the unextracted residues showed that 3 to 12.6% AR associated with the fulvic acid, humic acid and humin fraction.

The amount of avermectin B_{1a} declined from over 90% AR on Day 0 to up to 22.6% on Day 120 (Table 3). 8α-hydroxy-avermectin B_{1a}, formed as major metabolite under all four conditions, reached its highest level on Day 28; 8α-oxo-avermectin B_{1a} was formed above 10%

AR only in series 1, 2 and 3. Two other metabolites, 4,8α-dihydroxy-avermectin B_{1a} and 8α-oxo-4-hydroxy-avermectin B_{1a}, were found in amounts up to 9.9% depending on the incubation conditions (Table 5). Up to 19 minor metabolites were formed during the course of the study, each representing ≤ 5% AR.

Table 3 Recovery of radioactivity in % of applied radioactivity and distribution of metabolites after application of avermectin B_{1a} to soil

DAT, days	$^{14}CO_2$ and Volatiles	Aver-mectin B_{1a}	8α- oxo-	8α-hydroxy-	4,8α-di-hydroxy	8α-oxo-4-hydroxy-	Unknown [a]	Unextracted residues	Total
Series 1 (40% WHC, 30 °C)									
0	–	93.4	2.3	n.d.	n.d.	n.d.	3.9	1.0	100.1
3	0.3	82.4	1.5	4.9	0.4	n.d.	6.5	3.3	98.5
7	0.4	65.6	7.1	7.7	1.3	0.7	9.7	4.2	97.3
14	1.0	49.7	8.1	11.5	2.5	2.2	12.8	7.7	95.7
28	2.8	29.3	13.8	13.0	4.1	2.4	16.9	17.9	99.3
56	7.7	8.9	8.1	7.6	6.3	6.2	21.8	27.3	96.5
90	6.6	8.6	7.7	8.0	4.7	4.3	22.5	26.4	94.6
120	17.0	3.7	4.3	3.5	3.2	6.0	22.0	34.9	97.5
Series 2 (40% WHC, 20 °C)									
0	–	92.6	1.5	n.d.	n.d.	n.d.	2.9	1.3	98.4
3	0.1	81.0	2.9	3.4	0.3	n.d.	4.7	2.3	97.8
7	0.2	72.3	5.2	6.4	1.0	0.3	7.3	2.9	99.6
14	0.7	58.5	10.6	10.4	1.8	1.1	8.2	5.0	99.4
28	1.5	39.4	9.0	13.0	3.9	1.8	16.7	8.9	96.8
56	3.9	16.0	10.2	11.3	7.2	4.8	22.0	19.1	97.4
90	6.5	8.1	8.5	7.2	9.9	8.2	22.3	24.0	98.0
120	8.1	6.7	7.3	6.0	8.4	7.0	24.7	26.9	98.1
Series 3 (40% WHC, 10 °C)									
0	–	90.0	1.8	n.d.	n.d.	n.d.	2.8	1.2	96.1
3	< 0.1	85.3	2.4	2.3	n.d.	n.d.	3.4	1.8	97.8
7	0.1	86.1	3.7	4.7	0.6	n.d.	5.1	1.7	102.3
14	0.2	78.0	4.6	8.1	0.9	n.d.	7.0	2.7	101.5
28	0.4	64.9	5.6	11.2	1.6	0.7	9.5	5.9	101.8
56	1.0	46.0	7.0	13.2	3.1	1.6	16.0	9.2	99.6
90	1.4	32.0	10.8	15.0	4.7	2.3	21.8	11.7	103.5
120	1.5	22.6	10.8	12.7	7.1	4.4	22.2	13.8	97.8
Series 4 (25% WHC, 30 °C)									
0	–	93.0	2.2	n.d.	n.d.	n.d.	2.7	1.2	99.3
3	0.1	85.7	4.1	3.9	0.2	n.d.	4.3	3.2	101.6
7	0.2	73.3	5.5	7.5	0.7	n.d.	7.3	4.5	99.8
14	0.6	58.6	7.0	10.9	2.0	1.6	10.8	7.5	99.0
28	1.9	41.5	7.1	12.3	3.1	2.7	13.4	14.9	99.1
56	3.8	18.6	9.3	12.9	7.3	6.6	19.5	20.6	100.5
90	6.0	10.2	8.9	9.9	8.8	8.2	25.2	23.4	102.7
120	8.2	5.6	7.5	7.6	9.0	9.2	25.6	26.6	101.2

n.d. = Not detected

[a] Unknown = Sum of all other metabolites (up to 19; each single metabolite < 4.9%)

Table 4 summarizes the half-lives and DT_{90} values for avermectin B_{1a} and metabolites under various conditions.

Table 4 Degradation kinetics for [^{14}C]avermectin $B1_a$ under various conditions (Adam 2001)

	Series 1; 30 °C 40% WHC	Series 2; 20 °C 40% WHC	Series 3; 10 °C 40% WHC	Series 4; 30 °C 25% WHC
avermectin B_{1a}				
DT_{50}, days	16.0	21.3	52.7	22.7
DT_{90}, days	53.1	70.6	175.0	75.3
8α-oxo-avermectin B_{1a}				

DT_{50}, days	32.6	42.4	n.a.	49.1
DT_{90}, days	108.2	140.9	n.a.	163.0
8α-hydroxy-avermectin B_{1a}				
DT_{50}, days	22.7	35.6	n.a.	41.3
DT_{90}, days	75.3	118.2	n.a.	137.1

n.a. = Not applicable (metabolite concentration still increasing at the end of the study)

The degradation of [23-^{14}C]-labelled avermectin B_{1a} was investigated in Pappelacker soil (loamy sand), 18 Acres soil (sandy clay loam), and in Marsillargues soil (silty clay loam) under aerobic conditions at 20 ± 2 °C in the dark (Phaff, 2012). Soils were treated with avermectin B_{1a} at 0.125 mg/kg dry soil, incubated over 196 days under aerobic conditions in the dark with a soil moisture content of 40% water holding capacity (WHC). Samples were taken for analysis at 0 up to 196 days after treatment and submitted to exhaustive extraction procedures. The extracts were concentrated and analysed by TLC and HPLC.

The distribution of radioactivity and the metabolites at different sampling dates are summarized in Table 5. Non-extracted residues reached at least 30% AR. Day 126 samples submitted to reflux under neutral and acidic conditions released from 5.6 to 13.6% AR. Subsequent fractionation of the unextracted residues showed the up to 13.7% AR associated with fulvic acid, humic acid and humin. Avermectin B_{1a}residues declined from over 95% AR at the start of the experiment to < 7% AR at Day 196; 8α-oxo-avermectin $B_{1a}$and 8α-hydroxy-avermectin B_{1a} were the major metabolites found, in addition to 4,8α-dihydroxy-avermectin B_{1a} and 8α-oxo-4-hydroxy-avermectin B_{1a}.

Table 5 Recovery of radioactivity in % of applied radioactivity and distribution of metabolites after application of avermectin B_{1a} to various soils

Days after appl.	$^{14}CO_2$ and Volatiles	Avermectin B_{1a}	8α-oxo-avermectin B_{1a}	8α-hydroxy-avermectin B_{1a}	4,8α-di-hydroxy-avermectin B_{1a}	8α-oxo-4-hydroxy-avermectin B_{1a}	Unextracted residues	Total
Pappelacker soil								
0 [a]	–	98.0	n.d.	0.6	0.5	n.d.	0.1	100.9
3	n.d.	95.2	1.2	3.1	n.d.	n.d.	1.0	103.1
7 [a]	0.1	84.0	1.8	4.3	0.3	0.3	2.0	98.8
14	0.3	71.8	4.3	7.7	0.7	0.8	4.1	100.6
28 [a]	1.2	40.3	9.1	13.4	3.6	3.0	10.4	96.9
57 [a]	4.3	16.7	8.7	10.6	6.4	5.7	18.3	95.0
91	5.1	8.1	5.7	6.9	7.6	6.1	23.3	85.5
126 [a]	9.7	4.9	4.4	3.9	7.1	9.9	28.4	93.8
161	15.5	5.7	3.2	1.2	5.1	8.9	30.9	91.1
196 [a]	18.7	4.0	1.6	1.0	5.4	8.9	33.0	92.1
18 Acres Soil								
0 [a]	–	95.8	0.5	n.d.	n.d.	0.2	0.0	99.9
3	0.1	90.1	1.8	n.d.	n.d.	1.9	1.0	102.9
7 [a]	0.1	59.9	3.5	n.d.	0.4	3.9	5.4	99.8
14	0.7	40.9	3.8	0.6	0.1	3.3	14.0	101.1
28 [a]	2.3	15.4	2.6	0.7	0.3	2.2	26.2	95.4
57 [a]	6.4	9.9	1.8	0.9	0.2	0.6	34.8	91.7
91	12.4	8.3	1.4	0.9	0.1	0.3	39.1	93.4
126 [a]	12.5	6.9	1.1	0.7	0.5	0.2	39.6	91.3
161	12.9	5.1	0.6	0.2	n.d.	0.1	43.3	91.9
196 [a]	12.5	5.1	1.0	0.5	n.d.	0.2	44.1	90.9
Marsillargues Soil								
0 [a]	–	98.2	0.2	0.1	n.d.	n.d.	0.1	99.6
3	n.d.	91.3	0.5	1.5	0.1	n.d.	0.7	96.6
7 [a]	n.d.	93.2	1.1	2.9	0.2	n.d.	1.2	103.9
14	0.2	81.4	3.0	4.8	0.3	n.d.	3.2	100.5
28 [a]	0.5	61.8	4.2	7.1	0.6	0.4	6.2	96.7
57 [a]	1.2	44.2	5.1	8.1	1.8	2.0	11.2	93.7
91	4.1	26.8	4.7	8.8	3.1	2.3	18.4	95.8

Days after appl.	$^{14}CO_2$ and Volatiles	Avermectin B_{1a}	8α-oxo-avermectin B_{1a}	8α-hydroxy-avermectin B_{1a}	4,8α-di-hydroxy-avermectin B_{1a}	8α-oxo-4-hydroxy-avermectin B_{1a}	Unextracted residues	Total
126 [a]	4.1	18.2	6.0	7.6	3.1	2.5	22.9	92.3
161	6.9	12.4	5.3	6.0	5.5	5.2	27.2	90.4
196 [a]	13.4	6.6	3.5	4.0	2.2	2.6	30.0	91.5

n.d. = Not detected

[a] Mean of two duplicates

Table 6 summarizes the half-lives and DT_{90} values for avermectin B_{1a} and metabolites in various soils.

Table 6 Degradation kinetics for [^{14}C]avermectin B_{1a} and metabolites in various soils (Phaff, 2012)

	Pappelacker	18 Acres	Marsillargues
r^2 (first order kinetics)	0.99126	0.97373	0.9924
Avermectin B_{1a}			
DT_{50}, days	25.4	11.6 (10.7 [a])	52.2
DT_{90}, days	84.4	38.6 (53.9 [a])	173.3
8α-oxo-avermectin B_{1a}			
DT_{50}, days	20.9	–	49.5
DT_{90}, days	69.3	–	164.4
8α-hydroxy-avermectin B_{1a}			
DT_{50}, days	27.7	–	50.3
DT_{90}, days	92.1	–	167.1
4,8α-dihydroxy-avermectin B_{1a}			
DT_{50}, days	99.7	–	41.5
DT_{90}, days	331.2 [b]	–	137.8
8α-oxo-4-hydroxy--avermectin B_{1a}			
DT_{50}, days	192.2	–	22.2
DT_{90}, days	638.4 [b]	–	73.7

[a] Two compartment model

[b] Extrapolated values

The degradation of ^{3}H-labelled avermectin B_{1a} and ^{14}C-labelled avermectin B_{1a} was investigated in the laboratory under aerobic conditions in three different soils (Lufkin fine sandy loam, Houston clay and a coarse “construction grade” sand) incubated at 25 °C, at a soil moisture level of 75% of Field Capacity (Ku & Jacob, 1983). The test substance was applied to the soil at 0.1, 1.0 and 50 mg/kg. Samples were submitted to exhaustive extraction and the extracts analysed by TLC and HPLC. In order to account for the loss of radioactivity in all the aerobic soil studies a study was carried out with a biometer flask containing Lufkin fine sandy loam treated with ^{14}C-labelled avermectin B_{1a} (10 mg/kg) to determine the amount of $^{14}CO_2$ produced during the course of the study.

Avermectin B_{1a} degraded at a fairly rapid rate to at least 13 radioactive products, the major fraction being an equilibrium mixture (ratio of 1:2.5) of the 8-α hemiacetal derivative and the corresponding ring-opened hydroxy aldehyde derivative of avermectin B_{1a}, identified by NMR, MS and FTIR. Minor products, which individually never exceeded 2–3% AR, were found in addition to the metabolites listed in Table 7. The mineralisation of ^{14}C-labelled avermectin B_{1a} to carbon dioxide reached a maximum of 3.2% during a 21 week study.

Table 7 Soil degradation of [^{3}H]avermectin B_{1a} and [^{14}C]avermectin B_{1a} under aerobic conditions, in %AR [a]

Days after application	Volatiles [a]	Avermectin B_{1a}	8α-hydroxy avermectin B_{1a}	Non-extracted	Days after application	Avermectin B_{1a}	8α-hydroxy avermectin B_{1a}	Non-extracted
50 mg/kg [^{3}H]avermectin B_{1a}; Lufkin fine sandy loam					0.1 mg/kg [^{3}H]avermectin B_{1a}; Lufkin fine sandy loam,			
0	0	96	0.4	3.0	0	95.1	0	4.9
14	0.3	81	8.3	2.4	7	93.2	0	4.9
28	1.9	62.9	13.1	3.0	14	67.3	7.3	6.8
56	7.8	36.8	16.1	6.2	28	44.4	16.7	15.5
112	16.6	16.8	15.5	8.5	56	21.6	18.5	21.4
168	27.6	5.8	5.9	12.2	84	15.4	17.0	30.1
					168	5.3	13.3	35.0
1 mg/kg [^{3}H]avermectin B_{1a}; sand					1 mg/kg [^{3}H]avermectin B_{1a}; Lufkin fine sandy loam			
0	0	99.2	0	0.8	0	94.7	0	5.3
14	0.7	65.8	6.4	2.5	7	83.1	5.1	6.0
28	2.9	64.9	9.7	3.8	14	60.6	12.3	7.3
56	8.2	47.4	13.2	7.2	28	35.5	17.4	9.3
84	11.7	40.1	18.2	7.1	56	18.0	20.1	17.6
112	16.5	22.9	15.1	11.8	84	9.1	14.8	23.7
168	22.5	21.9	20.1	12.5	112	7.1	13.5	27.5
252	31.7	9.8	15.8	17.3	168	3.6	0.0	19.8
1 mg/kg [^{3}H]avermectin B_{1a}; Houston clay loam					0.1 mg/kg [^{3}H]avermectin B_{1a}; Houston clay loam			
0	0	94.4	0	5.6	0	94.9	0	5.1
28	2.6	60.4	4.9	10.1	21	54.6	11.2	9.1
56	6.6	51.6	6.0	11.5	28	47.8	13.4	13.1
84	12.6	22.4	13.0	17.0	56	29.6	18.4	17.2
112	17.9	22.7	14.8	15.8	84	19.4	18.7	20.2
168	25.6	11.3	8.5	18.8	112	12.5	14.4	21.2
252	33.4	11.2	11.4	18.1	168	12.0	14.3	26.3
448	45.5	8.1	5.2	16.8	252	7.5	13.7	21.2
1 mg/kg [^{14}C]avermectin B_{1a}; Lufkin fine sandy loam					1 mg/kg [^{14}C]avermectin B_{1a}; Lufkin fine sandy loam			
0	n.m.	97.9	0.0	2.1	0	99.0	0	1.0
28	n.m.	59.6	10.5	5.2	14	50.3	12.0	6.9
56	n.m.	45.8	15.0	7.7	28	25.2	16.1	10.9
84	n.m.	27.7	17.6	11.6	56	11.0	8.9	15.8
112	n.m.	18.4	11.8	27.4	84	8.1	8.4	18.8

[a] Average of duplicates

n.d. = Not detected

n.m. = Not measured

In experiments with [^{3}H]avermectin B_{1a} there were substantial quantities of volatile radioactive material (approximately 27.6–45.5% of the dose through the experiments) condensed in the water which was used to maintain the level of relative humidity. Since none of this radioactive material partitioned into dichloromethane it is concluded that it represents tritiated water rather than volatile organic materials. As the specific activity of ^{3}H-labelled avermectin B_{1a} was unchanged after 28 days of exposure it can be concluded that there was no apparent tritium exchange upon ageing of [^{3}H]avermectin B_{1a} in treated soil. The apparent release of tritium resulted from metabolic oxidation at the C5 position of the parent molecule or a degradate.

Unextracted residues increased with time, reaching a maximum of 12.2 to 35.0% AR. In most cases, there was a progressive increase in % AR which could not be accounted for in the radio-balance assessment, reaching values below 52% AR at the end of incubation. Since this loss was also observed among samples held in containers in which condensed volatile radioactive material was measured, it was assumed that the trapping of these volatiles was inefficient. Table 8 shows the half-lives estimated for avermectin B_{1a} in the various soils.

Table 8 Estimated DT_{50} values for degradation of [^{3}H] and [^{14}C]avermectin B_{1a} in various soils under aerobic conditions (Ku and Jacob 1983a)

Application rate [mg/kg soil]	Lufkin fine sandy loam	Construction grade sand	Houston clay
0.1	20 [a]	–	28
1.0	20 [b]	47 [a]	36 [a]
50	40 [a]	–	–

[a] [^{3}H] label

[b] [^{3}H] and [^{14}C] label

Soil photolysis

[^{14}C]avermectin B_{1a} was applied at a rate of 0.09 kg/ha onto the surface of a moist (75% FC) 2 mm soil layer and irradiated with a xenon arc light source in a wavelength range of 300–400 nm and at a light intensity of 84.7 ± 3.8 Wm^{-2}(Phaff, 2001). The mean temperature of the soil layers was kept at 24.5 ± 0.1 °C. The total irradiation time was 336 hours of xenon light (28 days incubation) equivalent to 47 days of natural summer sunlight (NSS) at latitudes 30 to 50 °N. Irradiation was performed in cycles of 12 hours xenon light and 12 hours darkness. Dark control samples were incubated for 28 days. Replicate samples were taken at 0 to 28 days, extracted and analysed by TLC and HPLC.

The overall recovery of radioactivity ranged between 96.9 and 102.8% AR for the irradiated samples (Table 9) and between 101.8 and 104.8% AR for the dark controls. At the end of the irradiation period, avermectin B_{1a} accounted for 19.5%AR in the irradiated soil (Table 9) and 86% AR in the control. In addition to the parent compound, six minor photoproducts were formed in the irradiated samples, two identified as 8α-oxo-avermectin B_{1a} and 8α-hydroxy-avermectin B_{1a} (Table 9). All other degradation products were below 5.3%. In the dark control samples four degradation products were observed, two of them were identified as 8α-oxo-avermectin B_{1a} and 8α-hydroxy-avermectin B_{1a} (≤ 5%). Under irradiation, non-extracted radioactivity increased from 0.3% at Day 0 up to 25.9% at the end of the study, and volatiles in the form of $^{14}CO_2$ amounted to 7.6%.

Table 9 Recovery of radioactivity in % of applied radioactivity and distribution of metabolites after application of avermectin B_{1a} to soil and irradiation

Incub. Time [d].	Irrd. Time [hours]	Irrd. Time Summer sunlight 30–50 °N [d]	Avermectin B_{1a}	8α-oxo-avermectin B_{1a}	8α-hydroxy-avermectin B_{1a}	Unknown [a]	Volatiles [a]	Unextracted residues	Total
0	0	0	100.3	1.0	n.d..	1.2	n.d..	0.3	102.8
2	24	3	67.7	4.1	2.6	10.6	0.4	15.6	101.0
4	48	6	77.3	3.6	2.9	8.1	0.7	9.1	101.7
6	72	10	66.7	4.1	2.8	11.1	1.6	13.6	100.1
10	120	17	52.4	3.7	4.0	22.8	2.5	16.2	101.5
15	180	25	42.4	3.4	3.5	27.1	3.1	18.8	98.3
21	252	35	28.6	5.7	3.3	31.2	4.5	22.6	97.2
28	336	47	19.5	4.5	3.1	36.2	7.6	25.9	96.9

n.d. = Not detected

[a] Sum of unidentified zones [TLC], ≤ 5.1% each

In the irradiated samples, avermectin B_{1a} degraded with a net photolysis DT_{50} of 21.7 days assuming first order kinetics (Table 10).

Table 10 Half-lives and DT_{90} values for avermectin B_{1a} on soil in the dark, under irradiation and converted to summer sunlight days

Incubation conditions	DT_{50}, days		DT_{90}, days	
	Sun test	30–50 °N	Sun test	30–50 °N
Dark controls; k_1 = 0.0058 (pseudo 1st order kinetics)	119.5		397.0	–
Irradiated; k_2 = 0.0597 (pseudo 1st order kinetics)	11.6	19.5	38.6	65.1
Irradiated, corrected for dark controls; k_3 = 0.0539 (k_2–k_1))	12.9	21.7	42.7	72.0

A soil photolysis study was conducted using [^{3}H]avermectin B_{1a} applied to a clay loam soil kept outdoors at latitude 40.5 ºN during the summer (Ku & Jacob, 1983a). Soil TLC plates (20 cm × 20 cm) were prepared by spreading a slurry of air dried soil (40 g) and methanol (30 mL) and air dried at room temperature before use. Approximately 50 µL of a solution of [^{3}H]avermectin B_{1a} (0.85 mg/mL methanol) was applied to several pre-scored soil thin layer plates (6.5 cm^2). The treated plates were exposed to sunlight and sampled at 0 to 31 hours. At each sampling time, a square of the soil thin film was carefully scrapped off the plates, transferred to a glass column, eluted with ethyl acetate followed by methanol and the eluents analysed by HPLC. Soil residues were air-dried and combusted for radio assay. Total recovery [%] of [^{3}H]avermectin B_{1a} from the soil thin layer extracts is presented in Table 11.

Table 11 Photodegradation of [^{3}H]avermectin B_{1a} in soil thin layer plates exposed to sunlight

Exposure Time [hr]	% [^{3}H]avermectin B_{1a} remaining		
	Ethyl acetate extract	Methanol extract	Total
0	93.1	5.7	98.8
1	84.7	6.4	91.1
2	82.7	6.2	88.9
4	78.0	6.9	84.9
8	70.5	8.6	79.1
16	56.8	6.4	63.2
31	27.3	5.3	32.6

A plot of the logarithm of the remaining [^{3}H]avermectin B_{1a} against time gives a straight line, indicating first order kinetics. The calculated half-life (DT_{50}) from this plot is approximately 21 hours. The metabolic pathway of avermectin B1$_a$ in soil is proposed in Figure 1.

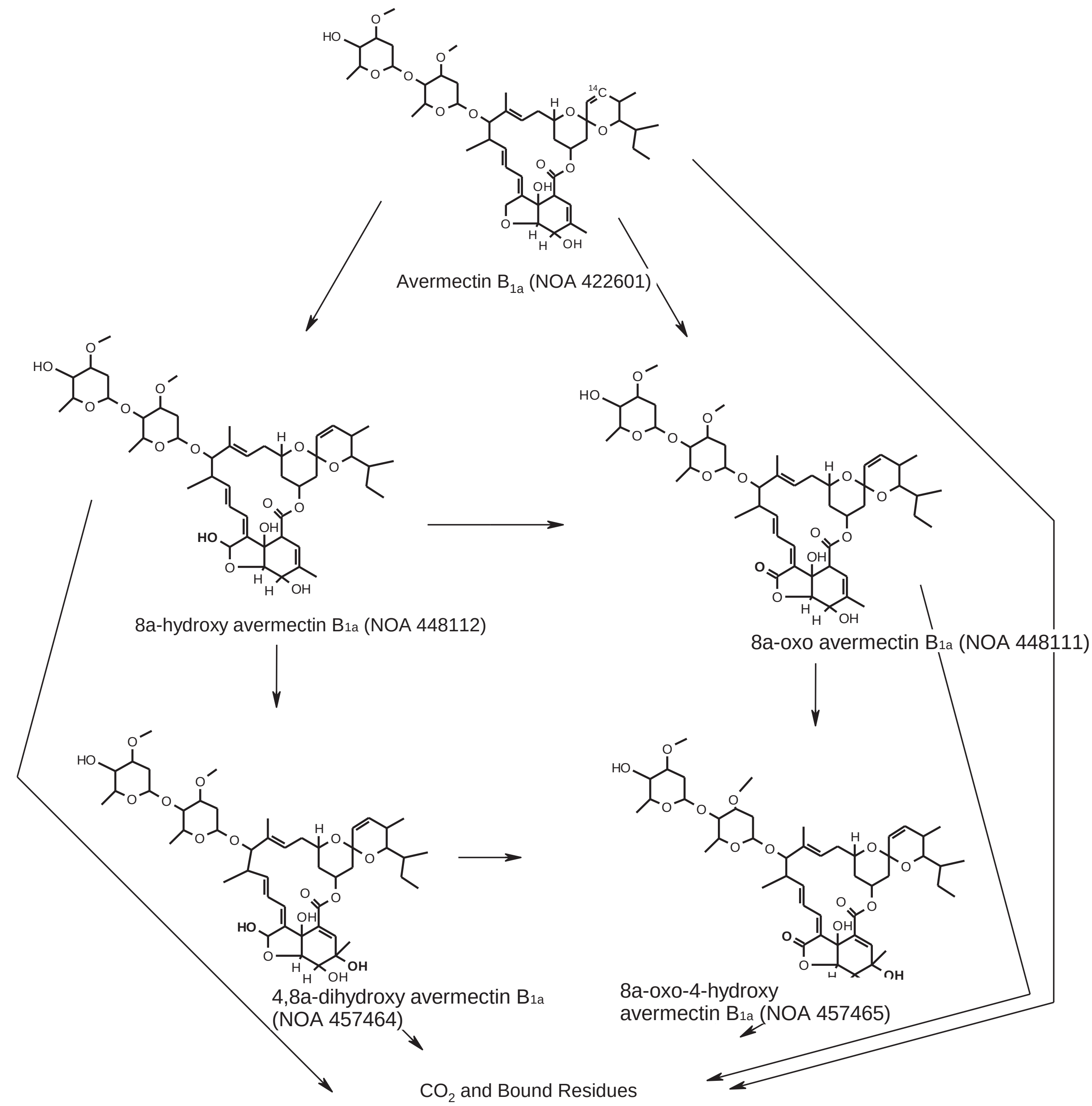


Figure 1 Metabolism of avermectin B_{1a} in soil

Plant metabolism

Citrus

The metabolism of [^{14}C]avermectin B_{1a} was investigated in citrus plants (oranges, lemons and grapefruit) (Maynard *et al.*, 1989). An open wooden frame with a fibreglass roof was constructed over each tree to minimize the reduction in residues by atmospheric precipitation. Solutions of [^{14}C]avermectin B_{1a}were prepared in an EC formulation blank (8 and 80 mg ai/L), and 0.5 mL solution was painted on each fruit using a small brush. Twenty one oranges, lemons and grapefruit were each treated with the 8 mg ai/L solution (4 µg), resulting in an initial concentration of 18 to 36 µg ai/kg on a whole fruit basis. Seventy eight oranges on two adjacent trees were treated with the 80 mg ai/L solution, resulting in initial deposits of 40 µg ai per whole fruit. Samples (three fruits) were collected on the day of application up to 12 weeks post application. For the 80 mg ai/L treatment, 15 additional fruits were sampled at weeks 2 to 12.

Each fruit was rinsed twice with methanol, the fruits peeled, the pulp rinsed with tap water, dried with a paper towel, combusted and the radioactivity, trapped as CO_2, measured. The skin was blended with dry ice, a portion taken for combustion analysis, the remainder extracted with acetone, the extracted dried, the residue partitioned between dichloromethane and water. The radioactivity remaining in the peel solids after acetone extraction was exhaustively extracted with methanol and tetrahydrofuran, followed by six additional methanol extractions or subjected to five successive Bligh-Dyer extractions (mixture of chloroform and methanol, dilution with chloroform and water, the chloroform layer containing all the lipids), methanol extraction, Soxhlet extraction, acid and enzyme hydrolysis procedures. Based on preliminary evidence that the degradation of avermectin B_{1a} was primarily photochemical in nature, the degradation of avermectin B_{1a} was investigated in thin film and aqueous photolysis. All extracts were analysed by reversed-phase HPLC.

The decline of the total radioactivity from the treated fruit over a 12-week period is shown in Table 12. At the end of the experiment, the residues ranged from 33.3% (grapefruit) to 49.8% (lemons) of the applied radioactivity (AR).

Table 12 Decline of radio-labelled residues in citrus following application of a [^{14}C]avermectin B_{1a} solution at 8 mg ai/L (4 µg/fruit) or 80 mg ai/L (40 µg/fruit)

Time (weeks)	Total Radioactive Residue, as % of the applied radioactivity [a] (in mg/kg)			
	Orange (8 mg ai/L)	Lemon (8 mg ai/L)	Grapefruit(8 mg ai/L)	Orange (80 mg ai/L)
0	100 (0.050)	100 (0.028)	100 (0.027)	100.0 (0.229)
1	61.3	72.5	60.5	90.0
2	58.7	72.2	52.9	79.0
4	51.6	59.2	48.2	66.3
8	38.4	45.2	41.5	45.1
12	43.9	49.8	33.3	41.6

[a] TRR is the sum of the radioactivity in all the fruit fractions.

In general, most of the residues were rinsed from the surface with methanol (Table 13). No residues were detected in the pulp portion without the peel/pulp interface at both rates for all fruits. When the interface was included, residues reached a maximum of 12–13%TRR after 8 weeks of application.

Table 13 Extracted residues (%TRR) in citrus following application of a [^{14}C]avermectin B1a solution with at 8 mg ai/L (4 µg/fruit) or 80 mg ai/L (40 µg/fruit)

	Orange (8 mg ai/L)			Lemon (8 mg ai/L)			Grapefruit (8 mg ai/L)			Orange (80 mg ai/L)		
Time (weeks)	Methanol rinse	Acetone Peel Extract	Total Extracted	Methanol rinse	Acetone Peel Extract	Total Extracted	Methanol rinse	Acetone Peel Extract	Total Extracted	Methanol rinse	Acetone Peel Extract	Total Extracted
0	98.6	1.1	99.7	100.0	0.0	100.0	98.4	1.7	100.1	98.6	1.2	99.8
1	74.8	16.5	91.3	59.9	20.6	80.5	68.4	20.0	88.4	87.2	8.5	95.7
2	64.1	15.5	79.6	45.0	26.2	71.2	59.3	16.7	76.0	84.0	8.7	92.7
4	52.3	21.0	73.3	28.8	24.9	53.7	43.7	22.3	66.0	73.9	13.3	87.2
8	32.2	31.0	63.2	13.4	29.8	43.2	34.2	22.6	56.8	41.7	28.1	69.8
12	36.3	21.4	57.7	6.7	30.8	37.5	32.7	18.9	51.6	40.9	19.2	60.1

Table 14 shows the characterization of the extracted residues from the fruits treated at the lowest rate. At least 90% TRR was found to be avermectin B_{1a} at Day 0, a level that decreased rapidly at Day 1 (maximum of 17.4% TRR in orange). After 1 day, most of the extracted residues were of a polar nature, accounting for at least 46% TRR at Day 12 in oranges. The moderately polar fraction (up to 12.5% TRR in 1 day orange samples) included 5 to 10 moieties. The 8,9-Z isomer of avermectin B_{1a}, also identified in the photolysis experiment on orange peel sections, accounted for < 5% TRR in all samples.

The acetone-extracted peel from the 2-week 8 mg/kg fruits was extracted three times with methanol followed by three extractions with THF, releasing 51, 40 and 54% of the matrix radioactivity (or 21, 11 and 25% of TRR) for the oranges, lemons, and grapefruits, respectively. The methanol and THF extracts were combined and partitioned between dichloromethane and water; approximately 60% of the radioactivity partitioned into the dichloromethane phase. The spent peel was extracted six times with methanol, and released an additional 7.0, 6.0 and 5.3% of the matrix radioactivity for the oranges, lemons and grapefruits, respectively. Characterization of the extracted radioactivity from the methanol and THF extractions produced polar, moderately polar, avermectin B_{1a} and the 8,9-Z isomer of avermectin B_{1a} fractions. Avermectin B_{1a} represented 2, 7 and 1% of the radioactivity for the oranges, lemons and grapefruits, respectively. The degradate characterization was qualitatively similar to that observed with the acetone extraction for the same samples.

Table 14 Characterization of the Total Extracted Residue (methanol rinse plus acetone peel extract) from fruits treated (4 µg/fruit) of [^{14}C]avermectin B_{1a}

Time (weeks)	Percent of Total Extracted Residue (%) [a]						Recovery as % of TRR
	Polar	Moderately Polar	Avermectin B_{1a}	8,9-Z isomer	Non-Polar	Column Wash	
Orange							
0	3.9	7.8	85.0	2.3	0.1	1.0	91.1
1	56.4	12.5	17.4	3.9	0.8	9.1	90.4
2	66.0	9.8	9.6	2.8	1.5	10.3	78.8
4	67.3	9.1	10.1	3.3	0.8	9.3	72.2
8	53.0	10.9	13.5	4.7	2.6	15.4	61.7
12	46.4	8.4	7.7	3.2	3.4	31.0	56.2
Lemons							
0	2.4	4.6	88.7	1.7	0.3	2.3	89.6
1	79.3	7.3	5.0	1.3	0.3	8.8	79.4
2	76.9	5.2	3.9	1.3	1.0	11.7	69.2
4	82.0	3.9	3.1	1.0	0.6	9.5	51.6
8	79.6	2.5	2.0	0.7	0.5	14.7	40.2
12	79.9	2.0	2.0	0.9	0.3	14.9	34.3
Grapefruit							
0	2.4	3.7	90.0	1.6	0.4	2.0	91.8
1	82.6	6.1	4.4	1.3	0.5	5.2	86.8
2	81.0	4.7	2.9	1.3	0.8	9.2	74.7
4	85.0	2.3	1.7	0.9	0.5	9.5	64.1
8	85.0	2.2	1.6	0.7	0.7	9.7	54.8
12	84.5	2.2	1.2	0.8	0.8	10.4	49.8

[a] Data are presented as percent of the normalized recovered radioactivity

Table 15 shows the work-up of non-extracted residues of the 12 week oranges using an 80 mg ai/L solution treatment. The acetone-extracted peel was extracted by five successive Bligh-Dyer procedures, which recovered 23.8% TRR. A fraction of this extract was tentatively identified by NMR and mass spectrometry as a mixture of linoleic fatty esters. Reverse-phase HPLC showed the major fraction of the radioactivity was polar degradates and avermectin B_{1a} represented between 9 and 12% TRR. The non-extracted residues after Bligh-Dyer (11.8% TRR) were subjected to Soxhlet extraction with methanol and the remaining peel subjected to acid hydrolysis (pH 1.3 for 24 hours at room temperature), leaving 8.8% TRR as non-extracted (Experiment 1). In another experiment, the peel solids remaining from the Bligh-Dyer were subjected to sequential enzymatic hydrolysis (cellulase, pectinase, and ß-glucosidase), that reduced the non-extracted residues to 7% TRR (Table 15).

Table 15 Removal of radioactivity from the orange peel non-extracted from fruit treated with an 80 mg ai/L solution (40 µg/fruit) of [^{14}C]avermectin B_{1a}

Fraction	% Radioactivity in Fraction [a]	% Whole Fruit TRR
12 week DAT 80 mg/kg		100.0
Methanol wash		40.9
Peel residue after methanol wash		54.7
Acetone Extraction		19.2
Bligh-Dyer Extraction		23.8
Experiment 1		
Bligh-Dyer Peel Solid	100	11.8
Methanol Soxhlet	10	1.2
Peel Solid after Soxhlet Extraction	90	10.6
Filtrate after Acid Hydrolysis	16	1.8
Peel Solid after Acid Hydrolysis	75	8.8
Experiment 2		
Bligh-Dyer Peel Solid	100	11.8
Filtrate after Cellulase, Pectinase, ß-glucosidase Hydrolysis	7	0.8
Peel Solid after Enzyme Hydrolysis	93	11.0

Values for solid samples were determined by subtraction of extracted residues from TRR. Combustion of the solid samples was not possible due to the condition of the solid with associated filter paper.

[a] Values are expressed as a percentage of the Bligh-Dyer Peel Solid

Celery

The metabolism of [^{3}H] and [^{14}C]avermectin B_{1a} was investigated in field-grown celery in two experiments (Moye, 1988). In the first, potted celery plants grown under field conditions were treated 10 times at weekly intervals and harvested at maturity. In the second experiment, potted celery plants were treated four times at weekly intervals and harvested as immature plants. [^{14}C]avermectin B_{1a} was applied at 16.8 g ai/ha and [^{3}H]avermectin B_{1a} was applied at 11.2 g ai/ha or 112 g ai/ha. The test material was applied to the foliar portion of the plants as EC formulated solutions at a rate equivalent to 460 L/ha. Two groups of three plants were harvested at each experiment. Immature celery plants were harvested from the [^{3}H]avermectin B_{1a} treatments at 0 day to 6 weeks after the fourth application and mature plants were harvested 0 days to 22 days after the tenth application of [^{3}H]avermectin B_{1a}. Immature celery plants were harvested from the [^{14}C]avermectin B_{1a} treatments at 0 days and 2 weeks after the fourth application and mature plants were harvested 0 day and 1 week after the tenth application. Samples were blended with acetone, an aliquot extracted three to six times with acetone, the residual solid dried and reconstituted with methanol/water (85:15) for chromatography, and further extracted with several solvents, including methanol/water (40:60 v/v). Hot DMSO was used to solubilise lignin and hot sulphuric acid to convert cellulose to glucose.

Residues in immature and mature celery from plants receiving 4 and 10 applications of [^{3}H]avermectin B_{1a} are shown in Table 16. In average, residues in immature leaves and stalks samples at 43 days after the 4th application accounted for < 1% of the residues at Day 0. In mature plants from the 11.2 g ai/ha treatment, residues after 22 days of the 10th application accounted for 23 and 15% of the residues at Day 0 in leaves and stalks, respectively. Similar results were found in plants treated at the higher rate.

Table 16 Radio-labelled residues in celery following application of [^{3}H]avermectin B_{1a} in µg/kg avermectin B_{1a} equivalents. Three plants per group.

	11.2 g/ha				112 g/ha	
DAT, days	Percent of Applied radioactivity (%)	Group 1	Group 2	Mean	Percent of Applied Dose (%)	Group 1
	Immature Plants(leaves/stalks)—4 applications					
0	1.33/0.31	2360/467	3110/632	2740/550	1.36/0.29	26800/6440
7	0.46/0.10	631/125	457/145	544/135	0.41/0.08	7830/2260
14	0.35/0.09	162/55.0	238/66.2	200/60.6	0.31/0.06	2690/851

29	0.21/0.07	25.4/6.20	26.1/7.64	25.7/6.90	0.19/0.04	286/57.1
43	0.20/0.14	13.1/4.82	9.81/3.36	11.5/4.10	0.21/0.08	96.7/21.6
Mature Plants(leaves/stalks)—10 applications						
0	1.86/0.56	207/30.8	186/27.1	196/28.9	2.56/0.56	2140/400
1	1.55/0.42	164/14.7	107/17.7	135/16.2	2.29/0.42	2170/331
3	1.85/0.52	140/14.9	114/11.6	127/13.3	1.84/0.52	1650/204
7	1.58/0.34	96.2/8.70	95.0/7.95	95.6/8.30	1.38/0.34	1134/238
15	1.18/0.28	60.2/6.41	62.5 /4.07	61.4/5.24	0.75/0.28	554/43.8
22	0.79/0.24	49.6/3.68	41.1/5.31	45.4/4.50	0.74/0.24	458/50.9

On average, residues in immature plants harvested at 14 days after the 4th application of [^{14}C]avermectin B_{1a} at 16.8 g/ha accounted for 5,4 and 12% of the 0 day residues for leaves and stalks, respectively (Table 17). In mature plants harvested after 7 days of the 10th application, these values were 38 and 54%, respectively.

Table 17 Radio-labelled residues in celery following application of [^{14}C]avermectin B_{1a} at 16.8 g/ha. Three plants per group.

DAT, days	Percent of Applied Dose (%)	Residue Found (in µg/kg avermectin B_{1a} equivalents)		
		Group 1	Group 2	Mean
Immature Plants (leaves/stalks)–4 applications				
0	1.67/0.19	4890/648	14300/1670	9570/1160
14	0.52/0.08	651/169	387/115	519/142
Mature Plants (leaves/stalks)—10 applications				
0	3.66/0.55	549/41.2	479/32.0	514/36.6
7	1.50/0.30	198/24.9	196/15.0	197/20.0

Most of the residues in immature and mature plants receiving treated with [^{3}H]avermectin B_{1a} and [^{14}C]avermectin B_{1a} were extracted with acetone at all sampling dates (Table 18).

Table 18 Acetone-extracted residues in celery following application of [^{3}H]avermectin B_{1a} at 11.2 and 112 g/ha and [^{14}C]avermectin B_{1a} at 16.8 g/ha, expressed as %TRR

DAT, days	Leaves			Stalks		
	[^{3}H] 11.2 g/ha	[^{3}H] 112 g/ha	[^{14}C] 16.8 g/ha	[^{3}H] 11.2 g/ha	[^{3}H] 112 g/ha	[^{14}C] 16.8 g/ha
	Immature plants					
0	95.8	96.6	97.1	97.0	95.2	96.0
7	80.6	78.3	–	83.3	78.9	–
14	71.4	68.2	69.9	82.1	74.0	74.
29	73.1	63.6	–	75.4	73.6	–
43	68.9	65.6	–	83.5	83.1	–
	Mature plants					
0	70.9	75.3	73.7	79.8	85.1	75.5
1	69.6	77.0	–	78.7	92.0	–
3	66.9	76.4	–	79.0	78.0	–
7	66.4	64.2	57.8	70.9	81.3	67.0
15	62.7	68.6	–	71.8	83.7	–
22	57.9	66.4	–	69.1	77.5	–

HPLC profiling of the acetone extracts from mature and immature celery plants are shown in Tables 19 and 20. Polar metabolites (more polar than parent) accounted for most of the residues in both leaves and stalks. In leaves, polar metabolite residues increased with the DAT, moderately polar metabolites remained relatively constant, while avermectin B_{1a} and its 8,9-Z isomer decreased during the sampling period. Residues in immature stalks showed a different profile, with polar metabolites decreasing and avermectin B_{1a} increasing after 7 days DAT. Further profiling indicated also the presence of 8-hydroxy avermectin B_{1a} (not quantified) and at least ten other unidentified minor components.

Table 19 Metabolic profile of acetone-extracted residues in immature celery following application of [^{3}H]avermectin B_{1a} and [^{14}C]avermectin B_{1a}, % the extracted residues

DAT, days [a]	[^{3}H]avermectin B_{1a} (11.2 g ai/ha)				[^{3}H]avermectin B_{1a} (112 g ai/ha)				[^{14}C]avermectin B_{1a} (16.8 g ai/ha)			
	Polar metabolites	Mod. polar metabolites	B_{1a}	8,9-Z isomer	Polar metabolites	Mod. polar metabolites	B_{1a}	8,9-Z isomer	Polar metabolites	Mod. polar metabolites	B_{1a}	8,9-Z isomer
Leaves												
0 (19)	4.3	16.5	73.4	5.3	3.3	14.1	74.9	7.7	4.7	19.2	65.3	10.8
7 (26)	54.5	19.9	21.2	4.4	50.3	22.3	22.8	4.5	–	–	–	–
14 (33)	53.1	22.8	18.7	5.3	50.0	19.8	25.6	4.6	62.0	17.0	15.8	5.2
29 (48)	66.2	18.2	14.3	1.4	69.8	13.0	14.5	2.6	–	–	–	–
43 (62)	68.4	14.8	15.8	1.1	61.3	12.2	20.5	5.9	–	–	–	–
Stalks												
0 (19)	4.8	22.8	67.7	4.6	3.3	15.3	80.7	0.7	5.6	28.5	54.8	11.2
7 (26)	42.3	27.2	27.0	3.6	36.0	32.1	28.2	3.6	–	–	–	–
14 (33)	33.4	22.3	37.1	4.6	43.4	19.7	30.7	6.2	50.9	14.9	29.2	5.0
29 (48)	34.6	19.6	43.3	2.6	33.4	21.0	37.5	8.1	–	–	–	–
43 (62)	22.7	20.3	56.1	1.0	30.4	24.9	38.6	6.1	–	–	–	–

[a] Numbers in parenthesis are days after 1st application (Four applications made to immature plants)

Table 20 Metabolic profile of acetone-extracted residues in mature celery following application of [^{3}H]avermectin B_{1a} and [^{14}C]avermectin B_{1a}, % the extracted residues

DAT, days [a]	[^{3}H]avermectin B_{1a} (11.2 g ai/ha)				[^{3}H]avermectin B_{1a} (112 g ai/ha)				[^{14}C]avermectin B_{1a} (16.8 g ai/ha)			
	Polar metabolites	Mod. polar metabolites	B_{1a}	8,9-Z isomer	Polar metabolites	Mod. polar metabolites	B_{1a}	8,9-Z isomer	Polar metabolites	Mod. polar metabolites	B_{1a}	8,9-Z isomer
Leaves												
0 (63)	61.0	19.7	15.2	4.0	42.2	19.8	33.0	5.0	33.8	22.5	38.6	5.2
1 (64)	63.4	19.0	14.5	3.1	46.2	23.7	23.9	6.2	–	–	–	–
3 (66)	67.3	17.4	12.7	2.6	65.1	19.4	11.5	4.0	–	–	–	–
7 (70)	68.3	16.7	11.4	2.7	63.7	18.8	14.8	2.7	71.6	16.2	9.8	2.1
15 (78)	72.3	14.5	10.6	1.9	66.7	19.5	9.9	3.9	–	–	–	–
22 (85)	80.1	11.5	7.5	1.0	71.7	17.7	8.3	2.1	–	–	–	–
Stalks												
0 (63)	36.2	17.9	36.3	4.7	22.3	18.5	56.6	2.7	43.0	18.3	31.6	7.1
1 (64)	41.3	25.2	30.3	3.3	26.0	17.0	55.6	1.3	–	–	–	–
3 (66)	35.3	24.6	36.4	3.3	34.2	18.9	43.7	3.3	–	–	–	–
7 (70)	42.5	20.7	32.4	4.1	31.4	19.2	44.0	5.4	66.7	12.2	17.2	3.5
15	48.1	20.6	26.	4.2	39.9	21.8	31.	6.9	–	–	–	–

DAT, days [a]	[^{3}H]avermectin B_{1a} (11.2 g ai/ha)				[^{3}H]avermectin B_{1a} (112 g ai/ha)				[^{14}C]avermectin B_{1a} (16.8 g ai/ha)			
	Polar metabolites	Mod. polar metabolites	B_{1a}	8,9-Z isomer	Polar metabolites	Mod. polar metabolites	B_{1a}	8,9-Z isomer	Polar metabolites	Mod. polar metabolites	B_{1a}	8,9-Z isomer
(78)			4				4					
22 (85)	51.5	15.4	28.3	4.8	48.3	14.1	29.6	6.1	–	–	–	–

[a] Numbers in parenthesis are days after 1st application (Four applications made to mature plants)

Table 21 shows the radioactivity released from the acetone non-extracted residues. In a preliminary experiment, residual solids following acetone extraction, which contain ^{3}H residues, were serially extracted with methanol/water (40:60), chloroform, dichloromethane, toluene and cyclohexane. Almost all (83%) of the radioactivity removed was associated with the methanol/water fraction, which was further treated with hot DMSO. Characterization of residues showed them to be mostly polar degradates of avermectin B_{1a} and < 1% TRR was released as parent compound. Further experiments with celery leaves using hot sulphuric acid indicated that 15% of the acetone non-extracted residues were incorporated into glucose. Residues in ^{3}H- and ^{14}C-leaves remaining after all treatments represented 10.6% and 4.1% of the TRR, respectively.

Table 21 Release of non-extracted residues from celery following application of [^{3}H] or [^{14}C]avermectin B_{1a}

Treatment/Product	Celery Leaves		Celery Stalks	
	Percent TRR	µg/kg eq.	Percent TRR	µg/kg eq.
[^{3}H]avermectin B_{1a} (112 g/ha 7 day DAT)				
Acetone	64.2	728	81.3	193
Remaining	35.8	485	18.7	53
Methanol/water	13.7	186	4.9	14
DMSO	6.9	94	4.0	11
Remaining	15.2	206	9.8	28
Sulphuric acid (glucose)	4.6	65		
Remaining	10.6	150		
[^{14}C]avermectin B_{1a} (16.8 g/ha 7 day DAT)				
Acetone	57.8	114	67.0	13.4
Remaining	42.2	83	33.0	7
Methanol/water	14.6	29	14.3	3
DMSO	9.0	18	9.9	2
Remaining	18.6	37	8.8	2
Sulphuric acid (glucose)	14.5	29		
Remaining	4.1	8		

Cotton

The metabolism of [^{14}C]avermectin B_{1a} was investigated in cotton in four experiments conducted in Texas and Florida (Wislock, 1986).

Experiment 1

Individual leaves were treated *in situ* by spreading 100 µg of [^{14}C]avermectin B_{1a} in an aqueous emulsion prepared from an EC formulation. Leaves were sampled in triplicate up to 8 days post-treatment, rinsed with alcohol and homogenized with acetone/water (9:1 v/v). Solids were separated by centrifugation and re-extracted twice with acetone.

Experiment 2

Small field plot of cotton plants was treated twice by foliar spray at 20 g ai/ha in a volume equivalent to 100 L/ha. Leaves were manually removed from plants when bolls reached maturity. Cotton bolls were de-linted with acid and the seeds extracted by Soxhlet with hexane for about 17 hours. The resultant solid fraction was extracted sequentially by reflux with methanol, acidic methanol, and basic methanol. The hexane extract was evaporated, the resulting oil fractionated using a silica gel column, and the major radioactive fraction hydrolysed under alkaline conditions.

Experiments 3 and 4

In Florida, cotton plants were grown in buckets under normal field conditions and treated three times by foliar spray using an EC formulation at 22.4 g ai/ha (Experiment 3) or at 224 g ai/ha (Experiment 4), both using 467 L/ha. The bolls were harvested approximately 20 days after the last treatment (DAT), delinted, and leaves, stems, branches, roots and bract/calyx from each treatment were sampled. The cottonseeds were extracted as described before.

The incorporation of the radioactivity into the cotton leaves in Experiment 1 is summarized in Table 22. The total surface residues decreased by first order kinetics, with residues decreasing from 99.7% of the applied dose at Day 0 to 19.3% at Day 8. The parent compound degraded at a much faster rate, with an apparent half-life of approximately 12 hours, accounting for 1.7% of the applied dose after 8 days.

Table 22 Fate of [^{14}C]avermectin B_{1a}, in % AR,after foliar application to individual cotton leaves at 100 µg/leaf (Experiment 1)

	External rinse with methanol			Internal extract (acetone and water 9:1)				
		Avermectin B_{1a}			Avermectin B_{1a}			
DAT	Total	TLC	HPLC	Total	TLC	HPLC	Non-extracted	Lost
0	99.7	99.2	99.4	0.6	0.4	0.6	0.1	0.0
1/4	84.7	57.1	40.3	3.7	2.6	2.0	2.9	8.7
1	82.7	41.0	36.4	8.6	5.7	4.6	6.3	2.4
2	60.1	13.9	9.7	8.2	4.4	3.2	12.6	19.1
4	43.7	4.2	2.4	9.5	3.2	2.5	26.1	20.7
8	19.3	1.7	1.0	15.9	2.6	3.0	23.1	41.7

Table 23 shows the results of Experiments 2 to 4. In Experiment 2, the highest residues were in the leaves (396 µg/kg), and the lowest in the lint (37 µg/kg) and seeds (50 µg/kg). In Experiment 3, the highest residues were in the leaves (46 µg/kg) and the lint (44 µg/kg), and the lowest in the seeds (10 µg/kg) and roots (6 µg/kg). In Experiment 4, the last treatment was made when approximately 50% of the bolls were open, which may explain the high residues found in the lint (750 µg/kg).

Table 23 Combustion analysis of cotton plants treated with [^{14}C]avermectin B_{1a} under field conditions, TRR, in µg/kg

	Experiment 2	Experiment 3	Experiment 4
Sample	2× 22.4 g/ha, 8 DAT	3× 22.4 g/ha, 20 DAT	3× 224 g/ha, 20 DAT
Roots	25 ± 3	5.5 ± 0.4	107 ± 7.5
Stems	70 ± 5	12.5 ± 1.2	169 ± 5.0
Leaves	396 ± 27	46.4 ± 1.2	404 ± 1.0
Bract/Calyx	228 ± 15	11.9 ± 0.6	97 ± 9.0
Whole seeds	50 ± 3	10.0 ± 0.8	85 ± 6.3
Lint	37 ± 3	43.5 ± 1.2	750 ± 7.3

The metabolic profiles based on HPLC/radiochemical analyses for both the methanol rinse and the acetone/water extracts of the leaves from Experiment 1 are shown in Table 24. The amount of the 8,9-Z isomer of avermectin B_{1a} ranged from 0.1 to 7.0% AR in both the methanol rinse and the acetone/water extract.

Table 24 Extracted radioactivity (% AR) from leaves of cotton plants treated with [^{14}C]avermectin B_{1a} (Experiment 1)

	0 day	0.25 day	1 day	2 day	4 day	8 day
External rinse with methanol						
Polar	–	24.2	27.8	41.2	37.2	17.0
Moderate Polar	–	13.0	12.3	7.4	3.4	1.2
Avermectin B_{1a}	99.4	40.2	36.4	9.7	2.4	1.0
8,9-Z isomer	–	7.0	6.2	1.8	0.7	0.1
Internal extract (acetone/water 9:1)						
Polar	–	1.0	2.4	3.4	5.7	11.4
Moderate Polar	–	0.4	0.9	0.8	0.7	0.7
Avermectin B_{1a}	–	2.0	4.6	3.2	2.5	3.0
8,9-Z isomer	–	0.3	0.7	0.7	0.6	0.8

The radioactive residues extracted from cotton seed at harvest are shown in Table 25. A major fraction of the residues was extracted with hexane, mainly from cottonseed oil. When the oil was chromatographed on silica gel, the residues were found to co-elute with triglycerides. The hydrolysis of this fraction under basic conditions released linoleic acid and palmitic acid. Non-extracted material amounted to 25% of the TRR after sequential extraction with five solvents in Experiment 2.

Table 25 Extracted radioactivity (%TRR) from cottonseed treated with [^{14}C]avermectin B_{1a} in the field

	Experiment 2	Experiment 3	Experiment 3
Fractions	2 × 22.4 g ai/ha	3 × 22.4 g ai/ha	3 × 224 g ai/ha
Hexane	26	35	30
Ethanol	0	–	–
Methanol	13	32	24
Methanol/HCl	9	5	3
Methanol/NaOH	28	28	34
Non-extracted	25	0	19
Total Recovery	101	100	110

The metabolism of [^{14}C]avermectin B_{1a} in citrus fruit, cotton leaves and celery leaves (also [^{3}H]avermectin B_{1a}) was compared with thin film photolysis on glass plates (Crouch, 1988). Nearly mature oranges were treated with [^{14}C]avermectin B_{1a} by application of an aqueous suspension of an EC formulation with a small brush, and oranges harvested at 1 and 2 weeks post-application. Individual leaves of cotton plants were treated with [^{14}C]avermectin B_{1a} and leaves harvested after 2, 4 and 8 days. Orange and cotton leaves were rinsed with methanol. Mature celery plants were treated with [^{3}H]avermectin B_{1a} at 112 g/ha or [^{14}C]avermectin B_{1a} at 16.8 g/ha, harvested at 0 or 7 days after the last application and leaves and stalks homogenized with acetone. In the separate photolysis experiment, a methanol solution of [^{14}C]avermectin B_{1a} was applied to the bottoms of two glass petri dishes and allowed to dry at room temperature. The dishes were placed under two racks of 275 W Suntanner bulbs located 66 cm from the dishes. After 19 hours, the avermectin film was solubilized in methanol, an aliquot removed, and the remaining methanol allowed to dry. The dish was replaced under the lights. The process was repeated at 30, 60 and 137 hours. The temperature under the bulbs was approximately 50 °C.

Reverse-phase HPLC profile of [^{3}H] or [^{14}C]avermectin B_{1a} and its degradates from citrus, cotton, celery and photolysis extracts showed the same profile (Table 26). Re-chromatography of the moderately polar fraction indicated the presence of 2–6 components, one co-chromatographed with 8α-hydroxy avermectin B_{1a}. Re-chromatography of the polar residues from the three treated crops and in the photolysis experiment showed four broad peaks. Spectrometric methods have indicated the presence of numerous multiple-oxygenated, hydrated or dehydrated and de-methylated species, which retain little of the macrocyclic characteristics of the avermectins.

Table 26 Profile of total solvent-extracted residues following application of avermectin B_{1a} to cotton leaves, citrus fruit, celery leaves and stalks and to glass plates using C_{18} HPLC

Sample	Time	% TRR in the fraction			% of Applied Dose
		Polar Fraction	Moderately Polar Fraction	Avermectin B_{1a} Fraction	
Cotton [a]					
Leaf surface wash	2 days	68.6	12.3	16.1	60.1
Leaf surface wash	4 days	85.1	7.8	5.5	43.7
Leaf surface wash	8 days	88.1	6.2	5.2	19.3
Leaf extract	8 days	71.7	4.4	18.9	15.9
Citrus Fruit					
Fruit surface (1×) wash	7 days	88.5	3.9	3.3	15.2
Fruit surface (30×) wash	7 days	74.2	7.2	11.1	17.9
Fruit surface (30×) wash	14 days	82.3	6.0	6.8	12.4
Celery [b]					
Stalk Extract (^3H, 5×)	0 days	22.3	18.5	56.6	1.03
Stalk Extract (^{14}C, 0.75×)	0 days	43.0	18.3	31.6	0.55
Stalk Extract (^{14}C, 0.75×)	7 days	66.7	12.2	17.2	0.30
Leaf Extract (^3H, 5×)	0 days	42.2	19.8	33.0	2.56
Leaf Extract (^{14}C, 0.75×)	0 days	33.8	22.5	38.6	3.66
Leaf Extract (^3H, 5×)	7 days	63.7	18.8	14.8	1.38
Leaf Extract (^{14}C, 0.75×)	7 days	71.6	16.2	9.8	1.50
In Vitro					
petri dish	19 hours	33.3	14.2	36.7	
petri dish	30 hours	81.0	9.5	7.3	
petri dish	60 hours			0.0	
petri dish	137 hours			0.0	

[a] Data from Wislocki *et al.*, 1986

[b] Data from Wislocki *et al.*, 1988

Tomato

Metabolism of avermectin B_{1a} was studied in greenhouse-grown tomato plants transplanted at growth stage BBCH 19 and placed in the greenhouse (Stingelin, 2003). Five spray applications (7 days interval) were made with formulated [23-^{14}C] avermectin B_{1a} at an average rate of 26.4 g/ha (2.2 g/hL) for the normal rate (Sub-Study 1) and three times (14 days interval) at an average rate of 280.8 g/ha (23.4 g/hL) for the exaggerated rate experiment (Sub-Study 2). The first treatment took place at growth stage BBCH 63 and the last at BBCH 71. For the Sub-Study 1, tomato fruits and leaves were collected one hour after the third and fifth application, and 3 to 28 days after the last treatment (final harvest). Sampling for the Sub-Study 2was performed one hour to 28 days after the last application. A cell tomato cells (variety Money Marker) grown as a cell suspension (Sub-Study 3) on medium AM1 under illumination at 27 °C were used for this study. Following sub-culturing, the cells were allowed to reach the log phase of growth prior to the addition of radio-labelled material, dissolved in dimethyl sulfoxide. The cell cultures were incubated for 41 days, separated from the medium by filtration under low vacuum, and washed three times with distilled water. This Sub-Study provided metabolites for identification purposes.

Tomato samples were washed with acetonitrile/water(50/50), washed tomatoes and leaves were homogenized in liquid nitrogen, extracted for at least six hours with acetonitrile/water (80/20 v/v), and the extraction procedure repeated five times or until the radioactivity in the last extract was less than 5% of the first extraction. The solid residues were extracted by microwave with 1-propanol/water (80/20) (10 min. at 100 °C, 20 min. at 120 °C, and 20 min. at 150 °C). Samples of the residual solid and after microwave extraction were air-dried, homogenized and taken for combustion to determine the non-extracted radioactivity.

Before partitioning the soluble radioactivity, samples were concentrated, the aqueous phase partitioned three times with n-hexane, dichloromethane or ethyl acetate. For storage stability purposes the surface radioactivity washes and the crude extract from the tomato fruit were re-analysed by 2-D TLC after storage at ≤ 8 °C. Additionally, tomato fruit free of surface radioactivity were re-extracted at the end of the experimental phase and the corresponding crude extract was re-analysed by 2-D TLC. Harvested cells (Sub-Study 3) were homogenized in acetonitrile:water (80/20), the homogenate centrifuged, re-extracted and analysed by TLC, reversed-phase HPLC and LC-MS.

Table 30 shows the distribution of radioactivity from the sub-studies. The non-extracted radioactivity (NE) in tomato fruit did not exceed 2% of TRR.

Table 30 Distribution of radioactivity and residual [^{14}C]avermectin B_{1a} in treated tomato samples

Sampling time	Crop Part	TRR [mg/kg] [a]	AvermectinB_{1a} [mg/kg] [a]	Surface Rad.[%] [b]	Extraction		NE [%] [b]	Total [%] [b]
					cold [%] [b]	MW [%] [b]		
Sub-Study 1 (5 × 26 g ai/ha)								
1 h after 3rd application	Tomato	0.314	0.282	95.3	5.4	0.1	0.2	101.0
	Leaves	3.869	3.706	–	112.8	n.a.	3.5	116.3
1 h after 5th application	Tomato	0.205	0.141	84.5	12.6	1.0	0.9	98.9
	Leaves	3.504	2.635	–	105.9	n.a.	4.7	110.5
3 d after 5th application	Tomato	0.098	0.062 [c]	69.1	30.3	2.1	1.8	103.3
	Leaves	4.418	3.205	–	115.5	n.a.	9.0	124.5
7 d after 5th application	Tomato	0.195	0.129 [c]	81.0	16.3	0.8	1.3	99.4
	Leaves	6.590	2.701	–	85.4	3.0	3.8	92.2
14 d after 5th application	Tomato	0.156	0.089 [c]	78.3	17.3	1.1	0.9	97.6
	Leaves	5.908	2.265	–	82.5	5.4	2.9	90.8
28 d after 5th application	Tomato	0.127	0.060 [c]	76.6	17.9	1.9	1.3	97.8
	Leaves	6.421	2.158	–	95.9	8.6	3.6	108.0
Sub-Study 2 (3 × 281 g ai/ha)								
1 h after 3rd application	Tomato	1.555	1.293	90.8	8.6	0.2	0.4	100.0
	Leaves	30.96	26.134	–	96.8	n.a.	3.2	100.0
3 d after 3rd application	Tomato	1.667	1.303	85.2	14.0	0.5	0.3	100.0
	Leaves	38.66	26.952	–	96.0	n.a.	4.0	100.0
7 d after 3rd application	Tomato	1.715	1.376	93.7	5.9	0.1	0.3	100.0
	Leaves	23.84	16.011	–	94.7	n.a.	5.3	100.0
14 d after 3rd application	Tomato	0.880	0.674	82.4	15.4	0.8	0.9	100.0
	Leaves	33.98	20.724	–	93.0	n.a.	7.0	100.0
28 d after 3rd application	Tomato	0.572	0.416	85.8	13.1	< 0.1	1.1	100.0
	Leaves	74.23	37.512	–	93.1	4.2	2.8	100.0

n.a. = Not analysed

MW = Microwave extraction

NE = Non-extracted [a] in avermectin B_{1a} equivalents; [b] in %TRR determined by the sum of surface + extracted + non-extracted radioactivity; [c] corrected for 8,9-Z isomer of avermectin B_{1a} content

Tables 28 and 29 show the metabolite fractions from the two sub-studies. Avermectin B_{1a} and its 8,9-Z isomer was the major fraction in all samples, accounting for at least 38.3%TRR (14 days leaves Sub-Study 1), in a ratio of approximately 9:1. Other identified metabolites are 8α-oxo-avermectin B_{1a}, 8α-hydroxy-avermectin B_{1a}, and 3''-O-desmethyl-avermectin B_{1a}, present at levels < 8%TRR in tomato and leaves at any sampling time in both experiments.

Table 28 Quantification of metabolite fractions in tomato fruit and leaves at various sampling times after the 5th application (in % of TRR), Sub-Study 1

Sampling (after last application)	0 days		3 days		7 days		14 days		28 days	
Plant Part	Fruits	Leaves	Fruits	Leaves	Fruits	Leaves	Fruits	Leaves	Fruits	Leaves
TRR [mg/kg] [a]	0.205	3.5	0.098	4.4	0.195	6.6	0.156	5.9	0.127	6.4
Metabolite Fraction	%TRR [b]	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR
Avermectin B_{1a}+ 8,9-Z isomer	68.7	75.2	70.2	72.5	72.0	41.0	63.9	38.3	51.4	33.6
8α-oxo-avermectin B_{1a}	3.1	6.3	3.4	7.3	5.2	6.0	4.3	4.7	5.5	4.9

Sampling (after last application)	0 days		3 days		7 days		14 days		28 days	
Plant Part	Fruits	Leaves	Fruits	Leaves	Fruits	Leaves	Fruits	Leaves	Fruits	Leaves
TRR [mg/kg] [a]	0.205	3.5	0.098	4.4	0.195	6.6	0.156	5.9	0.127	6.4
Metabolite Fraction	%TRR [b]	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR
8α-hydroxy- avermectin B_{1a}	2.9	1.7	2.9	2.8	1.9	2.1	2.2	2.1	2.0	2.8
3”-O-Desmethyl-avermectin B_{1a}	0.7	0.7	0.5	1.0	0.4	1.3	0.6	1.1	0.7	1.2
I_1	5.6	4.8	4.2	7.8	2.9	8.7	5.9	11.4	8.4	20.5
I_2									0.9	1.7
I_3										0.7
I_4 [c]	0.8	0.5	1.4	0.7	0.5	1.0	1.0	1.0	1.0	2.1
$I_{5–8}$	2.2	4.8	3.2	6.7	3.7	7.1	4.0	7.4	6.8	14.8
I_{14}			0.4		0.3		0.7		0.9	1.4
I_{15}									0.3	
I_{18}										1.1
I_{27}	0.5	0.8	0.4	1.8	0.4	0.7	0.5	0.4	0.4	0.8
I_{29}	1.0	1.2	1.2	1.1	0.8	0.7	1.1	1.0	1.5	
I_{31}	0.2	1.9	1.5	2.6	1.0	3.7	1.1	3.5	1.0	1.2
I_{34}	0.4	0.7	0.6	0.9	0.5	0.9	0.6	0.8	0.7	0.4
$I_{35–37}$	1.2	0.8	1.0	1.3	1.2	1.0	1.2	0.8	2.2	1.0
Unresolved Rad.	9.7	6.5	8.4	8.9	6.5	11.2	8.4	10.1	11.0	7.3
Sub. Total	97.1	5.9	99.4	115.5	97.3	85.4	95.6	82.5	94.5	95.9
Micro Wave Extract	1.0	–	2.1	–	0.8	3.0	1.1	5.4	1.9	8.6
Non-Extr. Rad.	0.9	4.7	1.8	9.0	1.3	3.8	0.9	2.9	1.3	3.6
Total	99.0	110.6	103.3	124.5	99.4	92.2	97.6	90.8	97.7	108.1
Accountability [d]	76.2	84.4	78.4	84.3	80.0	51.4	72.0	47.2	60.6	44.6

[a] In avermectin B_{1a} equivalents

[b] In % of the total radioactivity found in the plant part, surface + penetrated radioactivity (determined by combustion)

[c] I_4 was identified as ((2S,4S,6S,8R,9S)-8-sec-Butyl-4-hydroxy-9-methyl-1,7-dioxa-spiro[5.5]undec-10-en-2-yl)-acetic acid

[d] Sum of I_4 and all identified metabolites

Table 29 Quantification of metabolite fractions in tomato fruit and leaves at various sampling times after the 3rd application (in % of TRR), Sub-Study 2 (exaggerated application rate)

Sampling (after last application)	0 days		3 days		7 days		14 days		28 days	
Plant Part	Fruits	Leaves	Fruits	Leaves	Fruits	Leaves	Fruits	Leaves	Fruits	Leaves
TRR [mg/kg] [a]	1.55	30.9	1.66	38.6	1.71	23.8	0.88	33.9	0.57	74.2
Metabolite Fraction	%TRR [b]	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR
Avermectin B_{1a}+ 8,9-Z isomer	83.2	84.4	78.1	69.7	80.5	67.2	78.6	61.0	75.2	50.5
8α-oxo-avermectin B_{1a}	2.2	1.8	3.0	2.5	4.0	3.0	4.3	3.1	3.8	3.6
8α-hydroxy- avermectin B_{1a}	1.1	1.3	1.7	1.5	1.9	1.9	1.4	2.6	1.5	3.6
3”-O-Desmethyl-avermectin B_{1a}	0.7	0.5	0.4	0.6	0.4	1.4	0.4	1.3	0.5	1.1
I_1	1.1	1.6	1.0	3.6	0.4	4.7	0.9	5.5	4.1	8.6
I_4 [c]	0.2	0.1	0.6	0.2	0.4	0.5	0.4	0.5	0.7	0.8
$I_{5–12}$	4.7	1.7	5.8	4.3	6.0	5.4	6.1	5.9	3.0	10.3
I_{14}	0.2		1.6				0.5		0.6	
I_{15}	0.9		0.5		0.2		0.9			0.6
I_{18}		0.4	0.3	1.1	0.2		0.6	1.1		0.9
I_{27}		0.5	0.5	0.4	0.3	1.0	0.3	0.8	< 0.1	0.8
I_{29}	1.4		1.2	0.6	1.2	0.4	0.8	0.6	0.7	
I_{31}	0.9	0.8	1.4	2.4	0.9	1.2	0.9	1.2	0.9	1.6
I_{34}	0.4	0.3	0.5	0.6	0.7	0.6	0.8	0.7	0.5	0.8
$I_{35–37}$	0.4	0.6	0.5	1.0	0.6	0.8	0.4	0.9	1.3	0.9

Sampling (after last application)	0 days		3 days		7 days		14 days		28 days	
Plant Part	Fruits	Leaves	Fruits	Leaves	Fruits	Leaves	Fruits	Leaves	Fruits	Leaves
TRR [mg/kg] [a]	1.55	30.9	1.66	38.6	1.71	23.8	0.88	33.9	0.57	74.2
Metabolite Fraction	%TRR [b]	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR
Unresolved Rad.	2.0	2.2	2.1	8.0	2.3	6.7	2.7	7.8	7.1	8.6
Sub. Total	99.4	96.8	99.2	96.0	100	94.7	99.9	93.0	99.9	93.1
Micro Wave Extract	0.2	–	0.5	–	–	–	–	–	–	4.2
Non-Extr. Rad.	0.4	3.2	0.3	4.0	-	5.3	0.1	7.0	0.1	2.8
Total	100	100	100	100	100	100	100	100	100	100
Accountability [d]	87.4	88.1	83.8	74.5	87.2	74.0	85.1	68.5	81.7	59.6

[a] In avermectin B_{1a} equivalents

[b] In% of the total radioactivity found in the plant part, surface + penetrated radioactivity (determined by combustion)

[c] I_4 was identified as ((2S,4S,6S,8R,9S)-8-sec-Butyl-4-hydroxy-9-methyl-1,7-dioxa-spiro[5.5]undec-10-en-2-yl)-acetic acid

[d] Sum of I_4 and all identified metabolites

Metabolism of avermectin B_{1a} was studied in field-grown tomato plants under similar conditions as the greenhouse study (Stingelin, 2003a).Five spray applications were made using formulated [23-^{14}C] avermectin B_{1a} at an average rate of 26.4 g/ha (Sub-Study 1) and five times at an average application rate of 245.9 g/ha (Sub-Study 2). The tomato plants were kept unprotected and exposed to all weather conditions over the whole of the growing period. Sample analysis was similar to the greenhouse study.

Table 30 shows the distribution of radioactivity from the sub-studies. Total residues in tomato and leaves from Sub-Study 1 (normal rate) reached 0.017 and 0.716 mg/kg eq at the end of the experiment, respectively. The non-extracted radioactivity in tomato fruit did not exceed 10% of TRR.

Table 30 Distribution of radioactivity and residual [^{14}C]avermectin B_{1a} from the field study (Stingelin, 2003a)

Sampling time	Crop Part	TRR [mg/kg] [a]	Avermectin B_{1a} [mg/kg] [a]	Surface Rad. [%] [b]	Extraction		NE [%] [b]	Total [%] [b]
					cold [%] [b]	MW [%] [b]		
Sub-Study 1 (5 × 26.4 g/ha)								
1 h after 1st application	Tomato	0.019	0.015	88.3	n.a.	n.a.	11.7	100.0
	Leaves	0.982	0.937	n.a.	99.5	n.a.	0.9	100.4
1 h after 3rd application	Tomato	0.027	0.016	59.8	36.6	3.0	2.0	101.4
	Leaves	2.343	1.160	n.a.	79.0	4.5	7.8	91.4
1 h after 5th application	Tomato	0.026	0.016	64.1	30.3	4.5	2.2	101.1
	Leaves	1.424	0.683	n.a.	76.3	11.3	3.9	91.5
3 d after 5th application	Tomato	0.034	0.005	62.6	27.7	4.7	2.8	97.8
	Leaves	1.649	0.239	n.a.	73.1	11.2	8.3	92.6
7 d after 5th application	Tomato	0.020	0.005	30.8	51.5	6.8	6.3	95.4
	Leaves	0.840	0.044	n.a.	67.1	15.8	8.8	91.6
14 d after 5th application	Tomato	0.022	0.005	19.8	60.8	10.2	6.9	97.6
	Leaves	1.161	0.027	n.a.	65.4	17.5	9.6	92.5
28 d after 5th application	Tomato	0.017	0.001	19.3	62.7	9.6	8.0	99.6
	Leaves	0.716	0.015	n.a.	67.9	18.2	9.5	95.6
Sub-Study 2 (5 × 246 g/ha)								
7 d after 3rd application	Tomato	0.131	0.055	46.6	44.3	4.8	4.3	100.0
	Leaves	6.862	1.162	n.a.	78.0	14.2	6.2	98.4
28 d after 3rd application	Tomato	0.108	0.015	22.0	60.8	11.1	6.1	100.0
	Leaves	7.768	0.499	n.a.	70.6	13.8	6.1	90.5

n.a. = Not analysed

MW = Microwave extraction

NE = Non-extracted

[a] In avermectin B_{1a} equivalents

[b] In TRR found in the plant

Tables 31 and 32 show the metabolite fractions from the two sub-studies. The major metabolite fraction in all of the analysed samples was fraction avermectin B_{1a} and the 8,9-Z isomer of avermectin B_{1a} in a ratio of approximately 9:1, accounting for about 70–80%TRR at 0 days and decreasing over time. Other identified metabolites are 8α-oxo-avermectin B_{1a}, 8α-hydroxy-avermectin B_{1a}, and 3"-O-desmethyl-avermectin B_{1a}, present at levels < 7% TRR in tomato and leaves at any sampling time in both experiments.

Table 31 Quantification of metabolite fractions in/on tomato fruit at various sampling times (in % of TRR**)**, from the field study (Stingelin, 2003a)

Sampling after appl.	0 days after 1st	0 days after 3rd	0 days after 5th	3 days after 5th	7 days after 5th		14 days after 5th	28 days after 5th	
Sub-Study No.	1	1	1	1	1	2	1	1	2
TRR [mg/kg] [a]	0.019	0.027	0.026	0.034	0.020	0.131	0.022	0.017	0.108
Metabolite Fraction	%TRR [b]	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR
Avermectin B_{1a} and 8,9-Z isomer	80.8	60.8	62.3	14.3	25.3	38.1	23.5	7.1	25.4
8α-oxo-avermectin B_{1a}	2.1	1.3	1.8	3.7	2.5	2.9	0.4	2.7	0.8
8α-hydroxy- avermectin B_{1a}	0.4	0.6	0.4	2.3	0.6	2.0	0.5	1.6	2.2
I_1 [c]	1.2	14.9	11.9	22.6	36.7	11.8	29.2	19.0	28.8
I_2		3.6		7.1	4.2	1.3	3.3	9.0	2.5
I_4 [d]		3.7	2.6	5.9	1.7	1.4	1.9	4.4	0.9
I_5		1.6	0.6	8.5	3.4	6.9	1.6	15.1	3.3
I_{12}	0.3								
I_{14}		0.4		1.8	0.5	1.1	0.5		0.7
I_{15}						1.3			
I_{21}						1.0			1.4
I_{29}	0.3	0.4		0.8	0.4	1.8	0.2	1.4	1.8
I_{30}		0.3		1.3	0.3	0.7	0.5	0.2	0.3
I_{31}	0.9	0.7	0.6	2.2	0.4	1.4		0.1	0.4
I_{34}				1.2		2.5	0.3		3.7
unresolved Rad.	2.4	8.0	14.2	18.5	6.4	16.9	18.8	21.4	10.6
Sub. Total	88.3	96.4	94.4	90.3	82.3	90.9	80.6	82.0	82.8
MW-Extract	–	3.0	4.5	4.7	6.8	4.8	10.2	9.6	11.1
Non-Extr. Rad.	11.7	2.0	2.2	2.8	6.3	4.3	6.9	8.0	6.1
Total	100.0	101.4	101.1	97.8	95.4	100.0	97.6	99.6	100.0

[a] In avermectin B_{1a} equivalents

[b] In% TRR found in the plant part, surface + penetrated radioactivity (determined by combustion)

[c] For the surface radioactivity of tomato fruits it was demonstrated that the origin spot I_1 could be separated into two to three distinct peaks and unresolved radioactivity

[d] I_4 was identified as ((2S,4S,6S,8R,9S)-8-sec-Butyl-4-hydroxy-9-methyl-1,7-dioxa-spiro[5.5]undec-10-en-2-yl)-acetic acid

Table 32 Quantification of metabolite fractions in tomato leaves at various sampling times (%TRR)

Sampling after appl.	0 days after 1st	0 days after 3rd	0 days after 5th	3 days after 5th	7 days after 5th		14 days after 5th	28 days after 5th	
Sub-Study No.	1	1	1	1	1	2	1	1	2
TRR [mg/kg] [a]	0.982	2.34	1.42	1.65	0.84	6.86	1.16	0.71	7.76
Metabolite Fraction	%TRR [b]	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR	%TRR
Avermectin B_{1a} and 8,9-Z isomer	95.4	49.5	48.0	14.5	5.3	16.9	2.3	2.2	6.4
8α-oxo-avermectin B_{1a}	0.5	1.5	0.8	2.7	1.0	1.8	0.7	0.7	1.1
I_{34}					1.1	1.4	1.1		1.2
8α-hydroxy- avermectin B_{1a}	0.3	0.9	0.6	0.9	0.9	1.6	0.7	0.5	1.1
I_1 [c]	0.3	2.2	2.3	5.0	20.7	20.9	25.1	29.4	29.8
I_2		3.9	3.7	8.2	12.7	9.5	13.3	11.7	8.1

Sampling after appl.	0 days after 1st	0 days after 3rd	0 days after 5th	3 days after 5th	7 days after 5th		14 days after 5th	28 days after 5th	
Sub-Study No.	1	1	1	1	1	2	1	1	2
I_4 [d]		3.8	3.3	4.8	3.4	2.4		3.3	2.4
I_5		11.3	10.3	24.5	8.9	9.3	7.8	7.7	9.8
I_{14}						1.4	3.7		0.6
I_{16}			0.8	2.6				3.3	
I_{18}						1.8			3.6
I_{21}			0.3		0.9	1.3	0.7	0.6	1.3
I_{27}						0.2			
I_{29}	0.6	0.9	1.0	1.2	1.2	1.2	0.7	0.6	0.8
I_{30}		0.4	0.5	0.5	0.7	0.8	0.6	0.5	0.5
I_{31}	0.2	0.9	0.5	2.5	0.7	1.0	0.4		0.6
I_{35}		0.5							
unresolved Rad.	2.2	3.8	4.2	5.7	9.6	6.4	8.4	7.4	3.3
Sub. Total	99.5	79.0	76.2	73.1	67.1	78.0	65.4	67.9	70.6
MW-Extract	-	4.5	11.3	11.2	15.8	14.2	17.5	18.2	13.8
Non-Extr. Rad.	0.9	7.8	3.9	8.3	8.8	6.2	9.6	9.5	6.1
Total	100.4	91.4	91.5	92.6	91.6	98.4	92.5	95.6	90.5

[a] In avermectin B_{1a} equivalents

[b] In% of the total radioactivity found in the plant part, surface + penetrated radioactivity (determined by combustion)

[c] For the surface radioactivity of tomato fruits it was demonstrated that the origin spot I_1 could be separated into two to three distinct peaks and unresolved radioactivity

[d] I_4 was identified as ((2S,4S,6S,8R,9S)-8-sec-Butyl-4-hydroxy-9-methyl-1,7-dioxa-spiro[5.5]undec-10-en-2-yl)-acetic acid

The proposed metabolic pathway for avermectin B_{1a} in plants is shown in Figure 2.

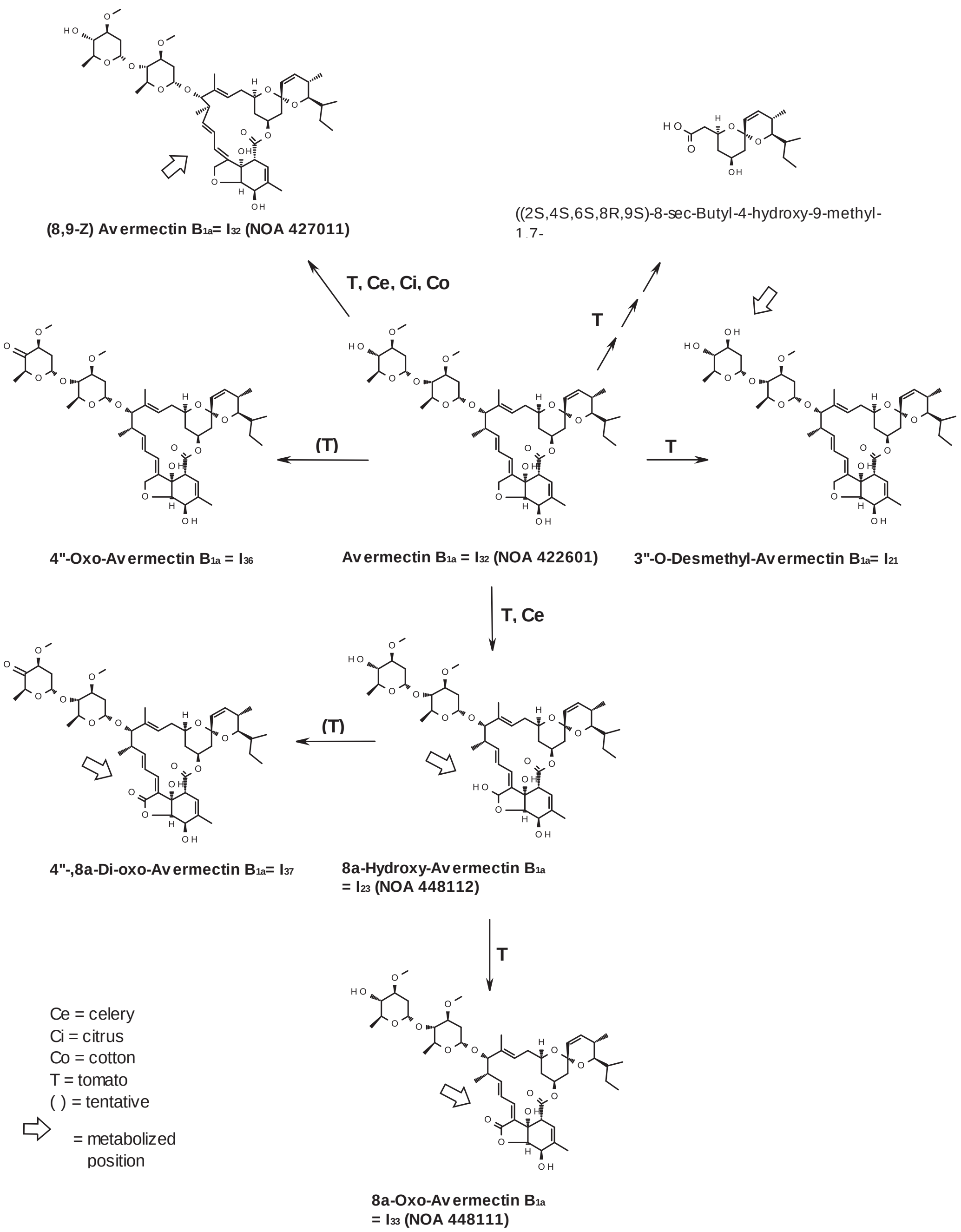


Figure 2 Proposed metabolic pathway of avermectin B_{1a} in plants

Confined rotational crop studies

The uptake, distribution and degradation of [^{14}C]avermectin B_{1a} were investigated in succeeding crops (Moye *et al.*, 1987). Sorghum, lettuce and carrot or turnip were planted in three soil types; a sandy soil, a sandy loam soil and a "muck" soil (high-organic drained swampland), typical US soils for cotton-growing in Georgia, vegetable-growing in California and vegetable-growing in Florida, respectively. The soils were filled into large tubes (three per soil type) and treated at 135 to 155% of the maximum label rate of 21.3 g ai/ha (for non-permanent crops). The sandy soil received three applications at 29.1 g ai/ha and sandy loam and muck soils received 12 applications at 33.6 g ai/ha. After the last application, each tube was divided into thirds and one rotational crop was planted in each third. Three plant-back intervals were used for each soil type. Sorghum and lettuce were planted in all soil types, turnip was planted in the muck soil and carrot planted in the sand and sandy loam soils. The plant-back intervals were 14, 123 and 365 days for the muck soil, 31, 120 and 365 days for the sandy soil and 29, 123 and 365 days for the sandy loam soil. All crops were seeded directly onto the plots. All rotational crops were harvested at 25, 50 and 100% (full) maturity. Soil cores (top 3 inches, middle 3 inches and bottom 3–6 inch layer) were also collected. Samples were combusted to measure radioactivity and lettuce (25% maturity) from a muck soil treatment was extracted with acetone.

The total radioactive residues in rotational crops following the treatment regimes are show in Table 33. The highest TRR was found in the 1/4 maturity lettuce sample from the muck soil (6.94 μg/kg), from which extraction with acetone released only 4.38% of the TRR. The resulting concentrations of radioactivity in succeeding crops were too low to characterize. Total radioactive residues in soil were also low (consistent with the low use rate). Residue levels in soil were proportional to the amount applied and decreased with the depth of sampling and the length of time between application and sampling (data not shown).

Table 33 Uptake and distribution of metabolites in rotational crops (3 plant-back intervals) after bare ground application of [^{14}C]avermectin B_{1a}

	Residue (μg/kg) in avermectin B_{1a} equivalents, mean of two groups														
	Sorghum						Lettuce			Carrots				Turnips	
	Leaf-Stem			Grain			Heads			Tops		Tubers		Tops	Tubers
	Muck	Sand	Sandy loam	Muck	Sand	Sandy loam	Muck	Sand	Sandy loam	Sand	Sandy loam	Sand	Sandy loam	Muck	
Plant-Back Interval (PBI)															
DAT	14	31	29	14	31	29	14	31	29	31	29	31	29	14	14
¼ Mature	4.78 [0.90]	< 0.85	2.54 [2.08]	–	–	–	6.94	0.92	2.40	1.08	2.21	1.49	0.87	0.83	3.45
½ Mature	1.74 [< 0.83]	< 6.03	11.6 [1.82]	–	–	–	2.52	0.77	0.45	0.37	0.62	0.58 [c]	0.42	0.37	0.80
Mature	7.4 [1.70 [a]]	< 2.23	Frost [1.74]	Frost [< 4.71]	< 4.13	Frost [< 3.95]	0.44	0.18	0.67	< 0.66	1.66	< 0.37	0.95	< 0.96	0.14
Plant-Back Interval (PBI)															
DAT	123	120	123	123	120	123	123	120	123	120	123	120	123	123	123
¼ Mature	2.73	3.54 [c]	2.19	–	–	–	0.24	0.48	1.49	0.47 [c]	1.29	1.05 [c]	1.86	< 0.66	1.12
½ Mature	6.56 [c]	< 0.62	1.60 [c]	–	–	–	0.27	0.33	0.50	< 0.68	0.99	< 1.05	1.01	< 1.05	0.18 [c]
Mature	0.60 [c]	< 0.84	1.19	< 5.69	< 0.99	< 1.39	0.15	< 0.15	0.16	< 1.07	2.62	0.91 [c]	1.93	< 0.61	< 0.71
Plant-Back Interval (PBI)															
DAT	365	365	365	365	365	365	365	365	365	365	365	365	365	365	365
¼ Mature	< 0.59	< 0.69	0.90 [c]	–	–	–	0.76	< 0.43	0.47	< 1.00	1.38	< 0.60	1.14	< 0.43	< 0.44
½ Mature	< 1.19	< 1.86	< 1.16	–	–	–	0.72	< 0.35	0.50 [c]	< 1.18	1.53	< 0.80	1.90	< 0.69	< 0.45
Mature	< 2.52	< 2.68	1.85 [c]	< 3.88	< 3.60	< 4.13	1.39	< 0.52	0.67	< 1.02	< 1.07	< 1.01	0.83 [c]	< 0.55	0.37

Values with < reflect the average of the limits of quantification calculated for each of the samples in each group

Values with [] are from repeats caused by frost damage

[a] Value for one group only. Second group had a value below the LOQ

Animal metabolism

Metabolism in rats

The metabolism of abamectin in rats was evaluated the WHO group of the JMPR at the present Meeting. In summary, orally administered [^{3}H] and [^{14}C] abamectin B_{1a} was rapidly and almost completely absorbed, and maximum concentrations in blood were achieved within 4–8 hours after administration. Radio-label was distributed to all major tissues and organs. Elimination of radio-label occurred predominantly by non-biliary excretion into the gastrointestinal tract and excretion with the faeces, while urinary excretion accounted for only 0.5 to 1.4 of the dose. Elimination was moderately fast, with 80 to 101% of the dose excreted within 96 hours. Rate of oral absorption, tissue distribution and excretion were independent of the dose level, treatment regime and/or sex; however, the depletion of tissue residues in males was approximately 2-fold more rapid than in females. There was no evidence for tissue accumulation on repeated administration. Metabolism of avermectin B_{1a} in the rat was moderate to extensive and proceeded predominantly via demethylation, hydroxylation, cleavage of the oleandrosyl ring, and oxidation reactions. The metabolite pattern in urine, faeces and bile was complex but qualitatively independent of the sex and the dose level with some quantitative variations. Eleven metabolites were isolated. Unchanged avermectin B_{1a} and the metabolites 3”-O-desmethyl abamectin B_{1a}, 24-hydroxymethyl abamectin B_{1a}, 27-hydroxymethyl abamectin B_{1a}, 3”-O-desmethyl-24-hydroxymethyl abamectin B_{1a} and 3”-O-desmethyl-27-hydroxymethyl abamectin B_{1a} represented the majority of the faecal radioactivity.

Metabolism in lactating goats

One study was conducted in lactating goats using [^{3}H]avermectin B_{1a} (Merricks, 1983, 1983a, 1983b; Maynard *et al.*, 1986; 1989). Six lactating Nubian goats were dosed daily by gelatine capsule for ten consecutive days with [^{3}H]avermectin B_{1a} at 0.005, 0.05 and 1.0 mg/day (two animals at each dose level), corresponding to 0.00125, 0.0125 and 0.25 ppm, respectively, in the diet. Urine and faeces were collected daily and each goat was milked twice daily. The animals were sacrificed on Day 11 approximately 24 hours after the last dose, and tissue samples collected.

Radioactivity in milk samples were counted directly, and tissue, urine and faeces samples were combusted prior to liquid scintillation counting (LSC). Edible tissues and milk were homogenized, extracted with dichloromethane, and the extract cleaned-up in a silica gel SPE for reverse-phase HPLC analysis. Avermectin B_{1a} residues were determined by reverse isotope dilution assay (RIDA). Profiling of the ethyl acetate eluate from the SPE column produced metabolite regions that were defined by retention times relative to avermectin B_{1a}. A column wash was used to investigate the non-polar fraction; a high dose fat sample was subjected to acid hydrolysis. Avermectin B_{1a} and a metabolite standard were also subjected to the acid hydrolysis conditions to determine reaction products. Since the radioactivity in goat tissue was low, a rat liver microsomal incubation of [^{14}C]avermectin B_{1a} was conducted to generate metabolite standards that could be co-chromatographed with in-vivo goat metabolites. Following incubation, the metabolites were purified by various reversed-phase HPLC and the structures identified by NMR and Fast Atom Bombardment (FAB)-Mass Spectrometry.

The majority (79 to 98%) of the administered dose was found in the faeces, with urine accounting for 0.1 to 0.6% of the daily dose in the highest dosed animals. Milk residues reached plateau (steady state) by Day 4 and were dose dependent (Table 34).

Table 34 Residue levels in milk from goats dosed with [^{3}H]avermectin B_{1a} (Maynard *et al.*, 1989)

Dose Day	Residue (µg/kg avermectin B_{1a} equivalents)											
	0.00125 ppm				0.0125 ppm				0.25 ppm			
	Goat 1		Goat 2		Goat 3		Goat 4		Goat 5 [a]		Goat 6	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
1	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.08	< 0.02	0.1	< 0.02	0.45	< 0.02	0.84
2	< 0.02	< 0.02	< 0.02	0.02	0.17	0.26	0.13	0.36	1.11	1.80	0.70	1.33
3	< 0.02	< 0.02	< 0.02	0.02	0.23	0.33	0.29	0.45	2.03	3.00	1.10	1.87
4	< 0.02	< 0.02	< 0.02	0.02	0.34	0.35	0.28	0.40	3.40	4.26	1.31	1.64

Dose Day	Residue (µg/kg avermectin B_{1a} equivalents)											
	0.00125 ppm				0.0125 ppm				0.25 ppm			
	Goat 1		Goat 2		Goat 3		Goat 4		Goat 5 [a]		Goat 6	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
5	< 0.02	< 0.02	< 0.02	0.03	0.26	0.30	0.31	0.38	3.40	4.48	1.38	1.87
6	0.02	0.02	< 0.02	0.03	0.23	0.36	0.32	0.48	3.29	4.48	1.18	2.16
7	< 0.02	0.02	< 0.02	0.03	0.23	0.38	0.28	0.47	3.11	4.71	1.31	2.33
8	< 0.02	0.02	0.02	0.03	0.20	0.29	0.31	0.44	3.19	4.25	1.31	2.06
9	< 0.02	< 0.02	< 0.02	0.03	0.21	0.29	0.29	0.41	3.60	3.71	1.30	1.93
10	< 0.02	< 0.02	< 0.02	< 0.02	0.22	0.34	0.34	0.41	3.05	4.70	1.36	2.26
11	< 0.02	S	0.02	S	0.25	S	0.29	S	5.05	S	1.62	S

[a] Animal off feed days 9–11, low water consumption. All other clinical observations were normal

S = Sacrifice after AM milking

The results of the tissue and organ assays for total radioactive residue (TRR) are shown in Table 35. Highest residues were found in liver, fat and kidney. Residues were not detected in muscle from the lower dose group (< 0.2 µg/kg eq.) and reached approximately 1.5 µg/kg eq. at the highest dose. Goat 5 at the highest dose level, had atypical consumption behaviour (off feed days 9–11, low water consumption).

Table 35 Residue levels in tissues from goats dosed with [^{3}H]avermectin B_{1a} for ten consecutive days(Maynard *et al.,* 1989)

Matrix	Residue (µg/kg avermectin B_{1a} equivalents)					
	0.00125 ppm		0.0125 ppm		0.25 ppm	
	Goat 1	Goat 2	Goat 3	Goat 4	Goat 5 [a]	Goat 6
Liver	0.2	0.6	2.1	3.5	98.0	16.4
Kidney	0.3	0.3	0.9	1.2	22.7	4.8
Lung	< 0.2	< 0.2	0.3	0.7	11.9	2.5
Peripheral fat	< 0.2	< 0.2	1.3	2.2	50.0	7.6
Omental fat	< 0.2	< 0.2	1.4	2.2	49.3	6.8
Leg muscle	< 0.2	< 0.2	0.3	0.4	7.6	1.7
Loin muscle	< 0.2	< 0.2	0.3	0.3	9.9	1.2
Mammary gland	< 0.2	< 0.2	0.4	0.6	13.3	3.6
Brain	< 0.2	< 0.2	< 0.2	< 0.2	1.0	0.3
Heart	< 0.2	< 0.2	0.4	0.8	20.6	2.6

[a] Animal off feed days 9–11, low water consumption. All other clinical observations were normal.

Avermectin B_{1a} was the major residue in all tissues, comprising to up to over 90% TRR (Table 36).

Table 36 Percent unchanged avermectin B_{1a} in tissues from goats dosed with [^{3}H]avermectin B_{1a} determined by reverse isotope dilution assay (RIDA), as % TRR (Maynard *et al.,* 1989)

Animal	Liver	Kidney	Leg Muscle	Loin Muscle	Fat	Milk
0.00125 ppm						
Goat 1	76 [a]	–	–	–	–	
Goat 2	77 [a]	–	–	–	–	
0.0125 ppm						
Goat 3	95 (92)	97	–	96 [a]	97	
Goat 4	87	92	–	–	99	
0.25 ppm						
Goat 5	95	94 (89)	91 (88) (91)	84	99	95 (98)
Goat 6	41 (40)	40 (37)	68	73	86	70 (79)

[a] Tissue residue levels were very low (0.2 µg/kg–0.6 µg/kg), so results should be considered estimates.

Results in parenthesis are repeat determinations

Tables 37 and 38 show the HPLC profile of the residues in tissues, assigned according to retention time relative to that of avermectin B_{1a}. Metabolite 24-hydroxymethyl-avermectin B_{1a}, was a major residue in liver and kidney of the lower dosing goats and was present at 2–11% TRR in milk from D3.

Table 37 Characterization of residue in goat liver extracts, in % of TRR, by reverse-phase chromatography

	0.00125 ppm		0.0125 ppm		0.25 ppm	
Fractions [a]	Goat 1	Goat 2	Goat 3	Goat 4	Goat 5	Goat 6
0.88–1.13, Avermectin B_{1a} [b]	50	40	91	88	90	63
0.11–0.30, 24-hydroxymethyl-avermectin B_{1a} [c]	37	54	1	3	3	26
0.30–0.71	5	3	1	2	2	5
0.71–0.88	5	2	2	4	3	2
1.13–1.55	3	1	1	2	1	1
Column Wash	[b]	[b]	3	1	1	3

[a] Average retention times relative to avermectin B_{1a}

[b] Sample radioactivity was low for these samples

[c] Identified from in-vitro rat liver microsomes

Table 38 Characterization of goat kidney, fat and muscle residues, in % of TRR, by reverse-phase chromatography

	0.00125 ppm						0.25 ppm					
	Kidney		Fat		Muscle (leg/loin)		Kidney		Fat		Muscle (leg/loin)	
Fraction [a]	G3	G4	G3	G4	G3	G 4	G5	G6	G 5	G6	G5	G6
Avermectin B_{1a}	83	83	99	93	–/88	–	84	42	93	85	86/89	77/79
24-hydroxymethyl-avermectin B_{1a}	5	6	< 0.5	< 0.5	–/2	–	6	43	< 0.5	3	1/1	10/10
0.30–0.71	2	2	< 0.5	< 0.5	–/2	–	3	9	1	3	2/2	5/4
0.71–0.88	2	4	< 0.5	1	–/5	–	4	2	1	1	8/5	3/4
1.13–1.55	2	1	< 0.5	1	–/5	–	2	1	1	1	2/1	2/2
Column Wash	5	3	0	5	0	–	1	3	5	8	1/2	4/3

[a] Retention times relative to avermectin B_{1a}

A second metabolite, isolated from the rat liver microsome incubations, and identified as 3"-desmethyl-avermectin B_{1a}, was isolated from Goat 5 liver, and was estimated to comprise < 1 to 5% TRR. This metabolite was identified in urine and faeces, but was not significant in tissues.

Fat tissue contained non-polar material (0–8%), which was captured in a methanol column wash. This fraction from Goat 6 (8%) was hydrolysed with sulphuric acid and analysed by HPLC. Avermectin B_{1a} was hydrolysed under these conditions to the monosaccharide-B_{1a} and further to the aglycone-B_{1a}; 24-hydroxymethyl avermectin B_{1a} was hydrolysed to the aglycone-24-hydroxymethyl avermectin B_{1a}. The reaction product produced from the fat corresponds to the aglycone-24-hydroxymethyl avermectin B_{1a} indicating that the fat must have contained 24-hydroxymethyl avermectin B_{1a} in a conjugated form. In summary Goat 6 fat tissue was shown to contain 85% avermectin B_{1a}, 3% unconjugated 24-hydroxymethyl avermectin B_{1a} and at least 3% conjugated 24-hydroxymethyl avermectin B_{1a} (acid hydrolysis released 40% of the 8% non-polar column-wash fraction).

Based on the structures identified, the metabolism of avermectin B_{1a} in the goat proceeds via oxidation of the methyl group (to a hydroxymethyl group) at the 24 carbon position and to a lesser extent demethylation at the 3" position. The proposed pathway is shown in Figure 3.

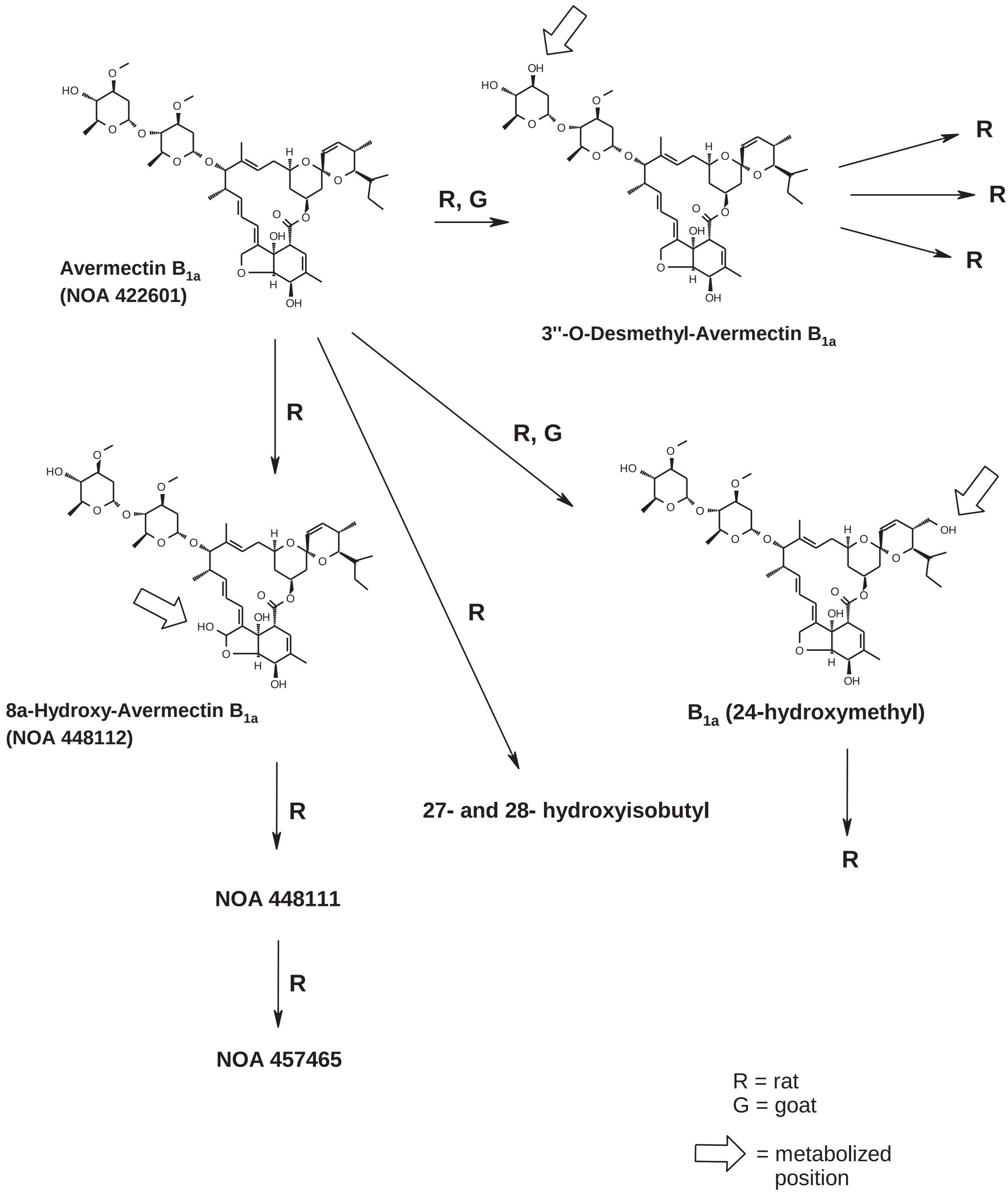


Figure 3 Metabolic pathway of avermectin B_{1a} in the goat and the rat

Residue analytical methods

Methods by HPLC-FL: avermectin B_{1a} is determined as the sum of avermectin B_{1a} and its 8,9-Z isomer and avermectin B_{1b} as the sum of avermectin B_{1b} and its 8,9-Z isomer

Method M-073 was developed to determine avermectin B_{1a}, avermectin B_{1b} and their 8,9-Z isomers in plant material (Arenas, 1996; 1998; Norton, 1997; Giles, 1996; Richard & Mackenzie, 2005).

Residues are extracted with acetonitrile/0.1% phosphoric acid and from the aqueous solution by partitioning into hexane. After adding sodium sulphate to the hexane phase, the organic extract is clean-up in an aminopropyl cartridge, and residues eluted with ethyl acetate/methanol. Fluorescent derivatives are formed by reaction with a mixture of triethylamine, trifluoroacetic anhydride and 1-methylimidazole, and determined by reversed-phase HPLC with fluorescence detection (HPLC-FL; Ex.: 365 nm, Em: 470 nm). HPLC analysis of avermectin B_{1a} and its 8,9-Z isomer results in a single peak, and avermectin B_{1a} is determined as the sum of avermectin B_{1a} and its 8,9-Z isomer and avermectin B_{1b} as the sum of avermectin B_{1b} and its 8,9-Z isomer. Validation data are summarized in Table 39. The limit of quantification for avermectin B_1 residues in crop matrices using Method M-073 was established at 0.002 mg/kg for each component analyte.

Table 39 Recovery data for method M-073 (HPLC-FL)

Commodity	Fortification level (mg/kg)	Range of recovery (%)	n	Mean (%)	RSD (%)	Report
Avermectin B_{1a}						
Fresh prunes	0.002	91–94	3	92	2	M-073 and M-073.1
	0.010	87–94	3	91	4	
	0.050	97–98	3	98	1	
	0.100	89–91	3	90	1	
Dried prunes	0.002	99–104	3	101	3	M-073 and M-073.1
	0.010	86–98	3	91	6	
	0.050	86–95	3	90	4	
	0.100	72–79	3	75	4	
Strawberries	0.001	71–98	2	85	-	E-97-MK-936-SB
	0.002	75–80	3	77	3	
	0.010	70–80	3	75	5	
	0.050	70	3	70	0	
Lettuce	0.002	79–95	5	88	7	RJ3670B
	0.020	88–100	5	92	5	
Radish, whole plant	0.002	96, 93, 100	3	96		MSD 430/961248
	0.010	94, 92, 98	3	95		
	0.031	101, 102, 96	3	100		
	1.027	93, 93, 92	3	93		
Radish, tubers	0.002	90, 92, 82	3	88		
	0.010	96, 93, 102	3	97		
	0.031	95, 100, 101	3	99		
Avermectin B_{1b}						
Fresh prunes	0.002	88–94	3	91	3	M-073 and M-073.1
Dried prunes	0.002	78–82	3	80	2	M-073 and M-073.1
Strawberries	0.002	70–75	3	73	3	E-97-MK-936-SB
Lettuce	0.002	72–92	5	86	7	RJ3670B
	0.020	84–96	5	88	5	
Avermectin B_{1a} 8,9-Z isomer						
Fresh prunes	0.002	100–101	3	101	1	M-073 and M-073.1
	0.010	96	3	96	0	
	0.050	103–105	3	104	1	
Dried prunes	0.002	87–109	4	99	11	M-073 and M-073.1
	0.010	90–113	4	99	10	
	0.050	98–104	3	100	3	
Strawberries	0.002	70–75	3	73	3	E-97-MK-936-SB
	0.010	70–73	3	72	2	
	0.050	70	3	70	0	
Lettuce	0.002	62–75	5	70	8	Richard, 2005; RJ3670B
	0.020	74–81	5	78	4	

The extractability of abamectin residues in citrus fruit (with acetone), celery (with acetone), cotton (with 90/10 v/v acetone/water) and tomatoes (with 80/20 v/v acetonitrile/water) was demonstrated in radio-labelled metabolism studies. The polarity of the extraction solvent used in analytical method M-073 is comparable to those used in the metabolism studies.

Methods M-007.1 (Cobin, 1995, 1995a; MSD 329/942555), 91-1 (Prabhu, 1991; Kvatemick, 1993, 1996; Richards & Mackenzie, 2005) and MSD 328/942104 (White, 1995) were developed to determine and quantify avermectin B_{1a}, avermectin B_{1b} and their 8,9-Z isomers in different crops, using similar procedures. Homogenized samples are extracted with a hexane/water/acetonitrile, hexane extracts are cleaned up in an aminopropyl SPE, residues derivatized with trifluoroacetic anhydride (reagent) and 1-methylimidazole (catalyst) and determined by reversed-phase HPLC-FL. Validation data for apple, tomato and grapes are summarized in Table 40.

Table 40 Validation recovery data for Methods M-007.1, 91.1 and MSD 328/942104 by HPLC/FL

Analyte	Fortification level (mg/kg)	Range of recovery (%)	n	Mean (%)	RSD (%)	Report
Apple						
Avermectin B_{1a}	0.01	71–100	12	82	12	Cobin, 1995a
	0.01	66–94	15	86	9	
	0.01	71–92	17	81	7	
	0.09	80–85	2	83	–	
Avermectin B_{1b}	0.005	78–84	2	81	–	
Tomato						
Avermectin B_{1a}	0.005	88–90	3	89	1	Kvatemick, 1993, 1996
	0.028	93–114	3	104	11	
	0.070	84–96	3	90	6	
Avermectin B_{1b}	0.002	92–102	3	96	5	
Avermectin B_{1a} 8,9-Z isomer	0.002	87	3	87	0	
	0.027	79–87	3	84	4	
	0.068	78–79	3	79	1	
Avermectin B_{1a}	0.002	95–106	5	102	4	Richards & Mackenzie, 2005a
	0.020	93–119	5	108	9	
Avermectin B_{1a} 8,9-Z isomer	0.002	79–94	5	91	7	
	0.020	97–99	5	97	1	
Avermectin B_{1b}	0.002	97–107	5	104	4	
	0.020	91–117	5	106	9	
Grape						
Avermectin B_{1a}	0.002	70–87	8	82	5	Prabhu, 1991
	0.050	76–91	9	83	5	
Avermectin B_{1b}	0.002	73–93	9	80	7	
Avermectin B_{1a} 8,9-Z isomer	0.002	71–88	8	78	7	
	0.050	70–93	8	77	9	
Avermectin B_{1a}	0.002	85–90	3	87	3	White, 1995
	0.100	92–110	3	99	10	
Avermectin B_{1a} 8,9-Z isomer	0.002	90–100	3	97	6	
Avermectin B_{1b}	0.002	80–90	3	85	6	
	0.100	94–103	3	98	5	

Methods M-044 and M-036.2 were developed to determine and quantify avermectin B_{1a}, avermectin B_{1b} and avermectin B_{1a} 8,9-Z isomer in fresh and immature hops and in dried hops, respectively (Norton, 1997; Report No. MER/AVE/96091). The methods involve rehydration and extraction with a methanol/deionised water mixture, partition into hexane and extract purified on aminopropyl SPE cartridges. The purified extract is derivatised using trifluoroacetic anhydride and residues analysed by HPLC-FL. Validation data are summarized in Table 41. The LOQ was 0.0025 mg/kg for avermectin B_{1a} and 0.005 mg/kg for avermectin B_{1b} and the 8,9-Z isomer of avermectin B_{1a}.

Table 41 Validation Recovery Data for Method M-044 and M-036.2 in hops by HPLC/FL (Norton, 1997)

Commodity	Fortification level (mg/kg)	Range of recovery (%)	n	Mean (%)	RSD (%)
Fresh hops					
Avermectin B_{1a}	0.0025	84–92	3	87	5
	0.005	86–102	3	92	10
	0.100	73–93	3	82	12
Avermectin B_{1b}	0.005	80–84	3	82	2
Avermectin B_{1a}8,9-Z isomer	0.005	84–92	3	88	5
	0.100	86–91	3	89	3
Immature hops					
Avermectin B_{1a}	0.0025	80–96	3	91	10
	0.005	94–100	3	97	3
	0.100	72–81	3	77	6
Avermectin B_{1b}	0.005	70–78	3	73	6
Avermectin B_{1a}8,9-Z isomer	0.005	102–104	3	103	1
	0.100	83–87	3	85	3
Dried hops					
Avermectin B_{1a}	0.0025	96–108	3	103	6
	0.005	98–106	3	101	4
	0.100	83–88	3	85	3
Avermectin B_{1b}	0.005	70–82	3	77	8
Avermectin B_{1a}8,9-Z isomer	0.005	98–106	3	102	4
	0.100	88–91	3	89	2

Methods by LC-MS/MS: determination of individual analytes

Method Meth-192, rev.2 was developed to determine and quantify avermectin B_{1a}, avermectin B_{1b} and their 8,9-Z isomers in plant material by LC-MS/MS. Transition ions for avermectin B_{1a} and its isomer ($[M+Na]^+$) were m/z = 895.5 → 751.5 for quantification and m/z = 895.5 → 449.2 for confirmation. Transitions for avermectin B_{1b} ($[M+Na]^+$) were m/z = 881.2 → 737.0 for quantification and m/z = 881.2 → 449.2 for confirmation. Residues are extracted with acetonitrile: 0.1% H_3PO_4 (25:75), partitioned into toluene and clean-up using aminopropyl solid phase extraction (SPE). The purified extract is evaporated, dissolved in acetonitrile, and then submitted to LC-MS/MS (reverse-phase column). The LOQ for all three analytes, in all matrices, is 0.002 ppm. Validation data are summarized in Table 42.

Table 42 Recovery data for Method Meth-192, rev.2, using LC-MS/MS

Commodity	Fortification level (mg/kg)	Range of recovery (%)	n	Mean (%)	RSD (%)	Report
Cherries						
Avermectin B_{1a}	0.002	93, 97	2	95	–	T005601-07
	0.02	91, 91	2	91	–	
Avermectin B_{1b}	0.002	85, 100	2	93	–	
	0.02	73, 94	2	84	–	
Avermectin B_{1a} 8,9-Z isomer	0.002	69, 84	2	77	–	
	0.02	77, 87	2	82	–	
Peach						
Avermectin B_{1a}	0.002	70, 78	2	74	–	T005601-07
	0.02	78, 98	2	88	–	
Avermectin B_{1b}	0.002	64, 93	2	79	–	
	0.02	79, 106	2	93	–	
Avermectin B_{1a} 8,9-Z isomer	0.002	66, 76	2	71	–	
	0.02	71, 86	2	79	–	
Plum						
Avermectin B_{1a}	0.002	75–99	5	84	11	T005601-07
	0.02	80–103	5	87	11	
	0.10	74, 77	2	76	–	

Commodity	Fortification level (mg/kg)	Range of recovery (%)	n	Mean (%)	RSD (%)	Report
Avermectin B_{1b}	0.002	104–111	3	108	3	
	0.02	64–128	3	100	33	
Avermectin B_{1a} 8,9-Z isomer	0.002	73–102	3	83	20	
	0.02	76–100	3	87	14	
Strawberries						
Avermectin B_{1a}	0.002	74–112	6	88	16	T001870-07
	0.0333	95	1	95	–	
	0.0336	92–111	3	100	10	
	0.05	95, 105	2	100	–	
	0.3333	101	1	101	–	
	0.50	82	1	82	–	
	0.838	90, 91	2	91	–	
Avermectin B_{1b}	0.002	84–133	4	108	20	
	0.022	83	1	83	–	
	0.0298	78	1	78	–	
	0.05	97, 118	2	108	–	
Avermectin B_{1a} 8,9-Z isomer	0.002	78, 98	2	88	–	
Grapes						
Avermectin B_{1a}	0.002	82–101	8	94	6.8	T005598-07
	0.02	85–101	6	94	7.0	
	0.20	93–105	4	99	5.5	
Avermectin B_{1b}	0.002	79–107	6	95	12	
	0.02	82–96	4	90	7.2	
	0.20	88–111	4	97	10	
Avermectin B_{1a} 8,9-Z isomer	0.002	88–100	6	94	4.8	
	0.02	82–92	4	86	5.7	
	0.20	91–103	4	97	5.1	
Celery						
Avermectin B_{1a}	0.002	68–97	4	83	15	T005593-07
	0.033	87–95	5	92	3.4	
	0.50	96	1	96	–	
Avermectin B_{1b}	0.002	72–91	4	81	12	
	0.50	74	1	74	–	
Cotton Seed						
Avermectin B_{1a}	0.002	110–120	5	116	3.6	T005597-07
	0.02	101–119	5	110	6.2	
Avermectin B_{1b}	0.002	72–86	5	76	8.0	
	0.02	70–81	5	77	5.3	
Avermectin B_{1a} 8,9-Z isomer	0.002	75–92	5	83	8.2	
	0.02	73–91	5	83	7.9	
Cotton Gin-Trash						
Avermectin B_{1a}	0.002	72–100	3	85	16	T005597-07
	0.02	65–80	3	74	11	
	1.2	66, 82	2	74	–	
Avermectin B_{1b}	0.002	55–125	3	87	40	
	0.02	67–86	3	79	13	
Avermectin B_{1a} 8,9-Z isomer	0.002	69–88	3	77	13	
	0.02	75–81	3	77	4.2	
Cottonseed Hulls						
Avermectin B_{1a}	0.002	70–90	3	78	13	T005597-07
	0.02	86–98	3	91	7.1	
Avermectin B_{1b}	0.002	73–84	3	79	7.2	
	0.02	70–93	3	85	15	
Avermectin B_{1a} 8,9-Z isomer	0.002	71–84	3	77	8.4	
	0.02	77–87	3	83	6.4	
Cotton Meal						
Avermectin B_{1a}	0.002	107	1	107	–	T005597-07
	0.02	82	1	82	–	
Avermectin B_{1b}	0.002	115	1	115	–	
	0.02	104	1	104	–	

Commodity	Fortification level (mg/kg)	Range of recovery (%)	n	Mean (%)	RSD (%)	Report
Avermectin B_{1a} 8,9-Z isomer	0.002	56	1	56	–	
	0.02	87	1	87	–	
Cotton Refined Oil						
Avermectin B_{1a}	0.002	82	1	82	–	T005597-07
	0.02	85	1	85	–	
Avermectin B_{1b}	0.002	87	1	87	–	
	0.02	89	1	89	–	
Avermectin B_{1a} 8,9-Z isomer	0.002	75	1	75	–	
	0.02	71	1	71	–	

Method 1002 Agri was developed to determine and quantify avermectin B_{1a} in raspberries (Baravelli, 2005). Homogenized samples were extracted with dichloromethane and filtered through sodium sulphate. Quantification was by reverse phase LC-MS/MS operating in Multiple Reaction Monitoring (MRM) mode. Transitions ($[M+H]^+$): m/z = 890.4 → 305.3 for quantification and m/z = 890.4 → 145.3 for confirmation. LOQ for avermectin B_{1a} was established at 0.02 mg/kg. Validation data for method 1002 on grapes are provided in Table 43.

Table 43 Recovery data for avermectin B_{1a} in raspberries by LC-MS/MS (Method 1002)

Commodity	Fortification level (mg/kg)	Range of Recovery (%)	n	Mean (%)	RSD (%)
Avermectin B_{1a}	0.02	92–103	6	100	4
	0.05	101, 106	2	104	–
	0.1	102, 108	2	105	–
	0.15	70, 83	2	74	–
	0.40	75, 85	2	80	–

Method REM 198.02 was developed for individual determination of avermectin B_{1a}, avermectin B_{1b} and the 8,9-Z isomer of avermectin B_{1a} in plant material and foodstuffs of animal origin (Satter, 2002; 2002a). Sample preparation and clean-up vary depending on the type of substrate. For high-water substrates, samples were extracted with methanol and cleaned up by C8-SPE. For fatty/oily substrates, the methanol extract was cleaned up by amino SPE, washed by partitioning with n-hexane and cleaned up by a C8-SPE tube. Hops samples were extracted with water and methanol, and after addition of a 5% calcium chloride solution partitioned with n-hexane and the organic phase was cleaned up by amino-SPE. Avermectin B_{1a}, avermectin B_{1b} and the 8,9-Z isomer of avermectin B_{1a} were eluted with a mixture of ethyl acetate/methanol. Residues were determined with a column-switching LC-MS/MS system. Validation data are summarized in Table 44. The LOQ was 0.002 mg/kg for all analytes in all crops, except for hops where the LOQ was 0.01 mg/kg.

Table 44 Recovery data for Method REM 198.02 in crop matrices by LC-MS/MS (n = 5)

		Avermectin B_{1a}			Avermectin B_{1b}			Avermectin B_{1a} 8,9-Z isomer		
	Fortification Level (mg/kg)	Range of recovery (%)	Mean (%)	RSD (%)	Range of recovery (%)	Mean (%)	RSD (%)	Range of recovery (%)	Mean (%)	RSD (%)
Tomato	0.002	75–86	80	5	77–90	85	7	77–90	85	6
	0.02	84–86	85	1	89–96	91	3	80–85	82	2
Orange	0.002	98–112	106	7	99–106	102	3	81–93	87	6
	0.02	89–98	91	4	92–100	96	3	82–94	86	6
Cotton seed	0.002	88–96	92	4	94–110	101	7	84–93	90	5
	0.02	90–97	94	3	97–102	100	2	87–96	92	4
Dried hops	0.01	53–71	62	11	61–80	70	12	52–70	59	13
	0.1	57–62	60	4	60–66	64	4	54–62	57	6
Fresh hops	0.01	99–106	103	3	100–110	107	4	91–97	95	3
	0.1	95–100	97	2	96–98	97	1	88–92	89	2

Validation data for Method REM 198.02 in foodstuffs of animal origin are shown in Table 45 (Satter, 2002; 2002a). LOQ for avermectin B_{1a}, avermectin B_{1b} and the 8,9-Z isomer of avermectin B_{1a} is 0.002 mg/kg in meat, milk and egg.

Table 45 Recovery data for Method REM 198.02 in animal matrices (LC-MS/MS)

		Avermectin B_{1a}			Avermectin B_{1b}			Avermectin B_{1a} 8,9-Z isomer		
Matrix	Fortification Level (mg/kg)	Range of recovery (%)	Mean (%)	RSD (%)	Range of recovery (%)	Mean (%)	RSD (%)	Range of recovery (%)	Mean (%)	RSD (%)
Meat	0.002 [a]	84–112	97	12	100–124	107	11	77–111	95	16
	0.02 [b]	93–119	101	11	98–116	105	7	90–115	100	11
Milk	0.002 [b]	79–94	87	6	82–104	95	9	79–96	89	7
	0.02 [b]	92–98	95	3	99–102	100	1	85–93	89	4
Eggs	0.002 [b]	86–103	93	7	98–111	104	5	79–97	87	10
	0.02 [a]	71–89	82	10	82–104	96	10	67–77	73	7

[a] n=4

[b] n=5

Storage stability under frozen conditions

The frozen storage stability of residues of avermectin $B_{1a}$was tested in homogenised orange, lemon and grapefruit peel samples (Cobin, 1987). Samples were stored at or below –10 °C up to 52 months. Avermectin B_{1a} was extracted from citrus peel and derivatized to yield a residue that was determined by HPLC-FL. The results are presented in Table 46.

Table 46 Storage stability of avermectin B_{1a} in citrus

		Orange Peel				Lemon peel		Grapefruit peel	
Interval, months	Fortification level, mg/kg	Residue remaining		Interval, months	Fortification level, mg/kg	Residue remaining		Residue remaining	
		mg/kg	%			mg/kg	%	mg/kg	%
0	0.025	0.018	73	0	0.005	0.005	106	0.0049	97
1	0.025	0.018	72		0.025	0.0235	94	0.0218	87
1.5	0.025	0.016	65	5.5	0.005	0.0024	48	0.0032	65
2.4	0.025	0.020	78		0.025	0.0128	51	0.0135	54
3.5	0.025	0.020	80	8.5	0.005	0.0049	98	0.0049	98
4	0.025	0.019	76		0.025	0.019	76	0.019	76
10.5	0.025	0.013	51	48	0.005	0.0047	93	0.0042	85
13.5	0.025	0.018	73		0.025	0.0198	79	0.0175	70
52	0.025	0.017	67						

Studies to investigate the storage stability of residues of avermectin B_{1a}, avermectin B_{1b} and the 8,9-Z isomer of avermectin B_{1a} were conducted in tomatoes (Wertz, 1987), celery (Hughes, 1989), strawberries (Siirila, 1997) and pears (Hicks, 1995). Homogenised tomatoes were fortified, stored at frozen conditions (–20 °C to –10 °C) for 15 up to 35 months and analysed by HPLC-FL against an avermectin B_{1a} standard curve. The results are shown in Table 47.

Table 47 Storage stability of avermectin B_1 in tomatoes, celery, strawberries and pears

	Fortification level, mg/kg	Residues remaining		Fortification level, mg/kg	Residues remaining		Fortification level, mg/kg	Residues remaining	
Interval, Months	Avermectin B_{1a}	mg/kg	%	Avermectin B_{1b}	mg/kg	%	Avermectin B_{1a} 8,9-Z-isomer	mg/kg	%
Tomatoes, –10 °C (Wertz, 1987)									
1 day	0.0101	0.0050	49	0.0038	0.0028	74	0.0092	0.0059	64
	0.0507	0.0385	76						
1	0.0101	0.0075	74	0.0038	0.0025	66	0.0092	0.0046	50

	Fortification level, mg/kg	Residues remaining		Fortification level, mg/kg	Residues remaining		Fortification level, mg/kg	Residues remaining	
Interval, Months	Avermectin B_{1a}	mg/kg	%	Avermectin B_{1b}	mg/kg	%	Avermectin B_{1a} 8,9-Z-isomer	mg/kg	%
	0.0507	0.032	63						
3	0.0101	0.0066	65	0.0038	0.0022	58	0.0092	0.0039	42
	0.0507	0.031	61						
6	0.0101	0.0062	61	0.0038	0.0025	66	0.0092	0.0046	50
	0.0507	0.0335	66						
15	0.0101	0.0083	82	0.0038	0.0039	103	0.0092	0.0084	91
	0.0507	0.0527	104						
Celery,–20 °C (Hughes, 1989)									
0	0.0104	0.0097	93	0.0152	0.0139	91	0.0095	0.0072	76
	0.206	0.184	89						
1	0.0104	0.0087	84	0.0152	0.0151	99	0.0095	0.0075	79
	0.206	0.174	84						
3	0.0104	0.0083	80	0.0152	0.0156	103	0.0095	0.0069	73
	0.206	0.176	85						
6	0.0104	0.0084	81	0.0152	0.0156	103	0.0095	0.008	84
	0.206	0.189	92						
12	0.0104	0.0088	85	0.0152	0.014	92	0.0095	0.0075	79
	0.206	0.187	91						
18	0.0104	0.0071	68	0.0152	0.0122	80	0.0095	0.0065	68
	0.206	0.160	78						
24	0.0104	0.0082	79	0.0152	0.0133	87	0.0095	0.0087	70
	0.206	0.146	71						
Strawberries, -20 °C (Siirila, 1997)									
0	0.0099	0.0096	97	0.0053	0.0049	92	0.01	0.0100	100
	0.071	0.0712	100						
1	0.0099	0.0095	96	0.0053	0.0047	89	0.01	0.0089	89
	0.071	0.0684	96						
3	0.0099	0.0082	83	0.0053	0.0046	87	0.01	0.0078	78
	0.071	0.0577	81						
6	0.0099	0.0098	99	0.0053	0.0050	94	0.01	0.0094	94
	0.071	0.0677	95						
12	0.0099	0.0090	91	0.0053	0.0051	96	0.01	0.0078	78
	0.071	0.0594	84						
18	0.0099	0.0092	93	0.0053	0.0053	100	0.01	0.0096	96
	0.071	0.0671	95						
24	0.0099	0.0097	98	0.0053	0.0058	109	0.01	0.0095	95
	0.071	0.0728	103						
Pears, –10 to –20 °C (Hicks, 1995)									
0	0.0102	0.0091	89	0.0053	0.0046	87	0.01	0.0087	87
	0.071	0.0640	90						
1.5	0.0102	0.0094	92	0.0053	0.0051	96	0.01	0.0095	95
	0.071	0.0605	85						
3	0.0102	0.0092	90	0.0053	0.0055	103	0.01	0.0099	99
	0.071	0.0630	89						
6	0.0102	0.0080	79	0.0053	0.0038	72	0.01	0.0087	87
	0.071	0.0510	72						
12	0.0102	0.0088	86	0.0053	0.0060	113	0.01	0.0097	97
	0.071	0.0595	84						
22	0.0102	0.0091	89	0.0053	0.0049	92	0.01	0.0097	97
	0.071	0.0640	91						
35	0.0102	0.0087	85	0.0053	0.0038	72	0.01	0.0095	95
	0.071	0.0610	86						

The frozen storage stability of residues of avermectin B_{1a} or its 8,9-Z isomer at –20 °C was tested separately in grapes and grape products over approximately 1 year (Cobin, 1998). Samples were analysed by HPLC- FL. The results are presented in Table 48.

Table 48 Storage stability of avermectin B_{1a} in grape and processed fractions

Matrix	Interval, months	Fortification level, mg/kg	Residues remaining of avermectin B_{1a}		Residues remaining of avermectin B_{1a} 8,9-Z isomer	
			mg/kg	%	mg/kg	%
Raisins	12.5	0.02	0.0056	28	0.0131	66
Raisin waste	12	0.02	0.0138	73	0.0123	62
Unwashed grapes	14.5	0.02	0.0149	75	0.0138	69
Washed grapes	14.5	0.02	0.0163	81	0.0146	73
Stems	12	0.02	0.0162	81	0.0150	75
Wet pomace	12 [a]	0.02	0.0160	80	0.0146	73
Dry pomace	12	0.02	0.0177	89	0.0177	89
Fresh juice	14	0.02	0.0133	67	0.0128	64
Processed juice	14	0.02	0.0148	74	0.0119	59

[a] Interval not given in the report but report reflected that all matrices were stored for about one year

Samples of tomatoes, runner beans (beans, green with pods), sunflower seeds, potatoes and orange peel were fortified with avermectin B_{1a}, avermectin B_{1b} and avermectin B_{1a} 8,9-Z-isomer, and stored for up to two years in a deep freezer at ≤ –18 °C (Kwiatkowski & Hill, 2007). Six replicate samples were analysed at zero time and triplicate samples were removed afterwards by LC-MS/MS (REM 198.02).The results presented are an average of multiple samples and are not corrected for freshly fortified recoveries.

Table 49 Storage stability of abamectin in crop commodities fortified at 0.05 mg/kg

	Interval, months	Residues remaining Avermectin B_{1a}		Residues remaining Avermectin B_{1a}		Residues remaining Avermectin B_{1a} ,9-Z-isomer	
Matrix		mg/kg	%	mg/kg	%	mg/kg	%
Tomatoes	0	0.05	100	0.05	100	0.04	100
	2.8	0.05	91	0.05	95	0.04	94
	5.3	0.04	86	0.04	85	0.04	97
	12.4	0.04	80	0.04	85	0.04	97
	17.7	0.04	85	0.04	84	0.04	101
	23.9	0.05	101	0.04	83	0.05	118
Beans (green with pod)	0	0.04	100	0.04	100	0.04	100
	3.0	0.04	97	0.04	94	0.03	90
	5.1	0.04	102	0.04	98	0.03	97
	12.6	0.03	94	0.04	97	0.03	92
	18.0	0.03	95	0.04	92	0.03	89
	24.2	0.04	103	0.04	94	0.04	103
Sunflower seeds	0	0.04	100	0.04	100	0.04	100
	2.8	0.04	116	0.04	102	0.05	109
	5.1	0.04	101	0.04	94	0.05	117
	11.8	0.04	98	0.04	96	0.04	97
	17.3	0.04	115	0.04	97	0.04	98
	24.2	0.05	121	0.04	103	0.04	106
Potatoes	0	0.04	100	0.04	100	0.04	100
	2.8	0.04	94	0.04	102	0.03	85
	5.1	0.04	102	0.04	106	0.04	94
	12.0	0.04	95	0.04	99	0.04	100
	17.5	0.04	96	0.04	93	0.04	91
	23.9	0.04	98	0.04	91	0.04	104
Orange peel	0	0.04	100	0.04	100	0.04	100
	3.0	0.04	86	0.04	91	0.03	87
	5.9	0.04	90	0.04	94	0.04	102
	13.3	0.04	93	0.04	100	0.04	98

USE PATTERNS

Abamectin is registered in many countries using high or low volume sprayers or, in some countries, by very-low volume or ultra-low volume equipment for aerial application. Table 50 shows the registered uses in countries where supervised trials have been conducted or in countries with GAPs similar to those where the supervised trials were carried out.

Table 50 Selected registered uses for abamectin as foliar spray (EC formulation 18 g ai/L)

Crop	Country	Application			DAT (days)
		Rate g ai/ha	Water L/ha	No or/ Season max kg ai/ ha	
Avocado	USA	26	> 935	2	14
Bean (green with pods)	Spain	18	500–1000	3	3
Bean (dry)	USA	21	> 94	2	7
Raspberry	Italy	22	not specified	1	7
Celeriac	USA	21	> 187	2	7
Celery	Greece	9	500	4	14
	USA	21	> 187	2	7
Citrus	USA	26	> 94	3 [a]	7
Coffee	Brazil	27	400	1	14
Cotton	Spain	18	1000	3	3
	USA	21	> 45.5	2	20
Cucumber/gherkin	Denmark	22	250–1500 [b]	4	3
Eggplant	Greece	22	500–1200	4	3
Endive	Slovenia	18	not specified	1	7
Fruiting vegetables, except curcubits. Include pepper, chilli pepper	USA	21	> 468	2	7
Grape	USA	21	> 468	2	28
Hops	Slovenia	22	300–400	2	28
	USA	21	> 374	2	28
Leek	Belgium	9	1000	3	7
Lettuce	Greece	9	500	4	14
	Italy	18	not specified	3	7
Mango	Brazil	14	800	4	7
Melon/Watermelon	Denmark	22	250–1500 [b]	3	3
Onion/shallot	USA	21	> 187	2	30
Papaya	Brazil	22	1000	3	14
Peach	Italy	22	not specified	2	14
Peanut	Argentina	1.8	not specified	1	30
Pepper	Denmark	22	500–1500 [b]	5	3
Pome Fruit	Italy	22	not specified	2	28
Radish	Belgium	9	> 1000	2	14
Rice	China	14	682	2	21
Spinach	USA	21	> 187	2	7
Stone Fruit	USA	26	> 374	2	21
Strawberries	Denmark	22	250–1500 [b]	3	3
	USA	22	> 468	4	3
Tomato	Denmark	22	250–1500 [b]	5	3
	Greece	22	500–1200	4	3
Tree Nuts	USA	26	> 374	2	21
Tuberous and corm vegetables, include potato, sweet potato and yam	USA	21	> 187	2	14

[a] Subject to a maximum seasonal application of 53 g ai/ha

[b] Greenhouse application only

RESIDUES RESULTING FROM SUPERVISED TRIALS ON CROPS

Supervised residue trials conducted with abamectin on a variety of crops in China, Brazil, European countries, and USA from 1986 to 2012 were submitted to the Meeting. All trials were conducted using foliar spray of EC formulation. Studies were conducted according to GLP, except those conducted before the 1990's. Concurrent determination of residues in untreated crops gave residues < LOQ. Residues of abamectin arising from independent trials that used patterns where rate or days after treatment (DAT) ± 25% of GAP are underlined and considered for estimation of maximum residue levels and STMRs. Trials which were not exactly within that range but, with the support of additional information were also considered for the estimations were also underlined.

When residues in samples harvested at a later stage were higher than those found at the critical DAT, they were used for the estimations. When multiple field samples from one plots were taken for analysis, the mean was selected for the estimations. When two field trials were conducted in the same location in the same period/season, only the highest result was considered. For protected trials, the location was considered not relevant.

The data submitted are summarized in Table 51. In total, 601 supervised trials were submitted and food commodities analysed for residues; in some trials, feed commodities were also analysed.

Table 51 Summary of supervised residue trials conducted with abamectin

Commodity	Location	Number of trials	Table	Commodity	Location	Number of trials	Table
Citrus	USA	21	52	Lettuce	Europe	34	70
Pome fruit	Europe	42	53	Spinach	USA	11	71
Cherry	USA	18	54	Bean (green with pods)	Europe	16	72
Peach	Europe/USA	12/17	55	Bean (dry)	USA	12	73
Plums	USA	17	56	Celeriac	USA	2	74
Raspberry	Italy	4	57	Potato	USA	18	75
Strawberries	Europe/USA	8/28	58	Radish	Netherlands	3	76
Grape	USA	24	59	Celery	Europe/USA	7/6	77
Avocado	USA	5	60	Rice	China	24	78
Mango	Brazil	5	61	Tree nuts	USA	32	79
Papaya	Brazil	12	62	Cotton	Europe/USA	8/14	80
Onion/shallot	USA	8	63	Peanut	Brazil	4	81
Leek	Europe	12	64	Coffee	Brazil	5	82
Cucumber/gherkin	Europe	29	65	Hops	Europe/USA	8/4	83
Melon	Europe	13	66	Rice husk	China	25	84
Pepper	Europe/USA	18/4	67	Green bean, vines	Europe	8	85
Tomato	Europe	43	68	Almond hulls	USA	10	86
Eggplant	France	2	69	Cotton hulls	Europe	8	87

Citrus fruits

Twenty one residue trials on citrus were carried out in the USA in 1986. Samples were stored deep-frozen for a maximum of 6.5 months (198 days) and analysed by HPLC-FL. In this study, LOQ was 0.005 mg/kg and LOD was 0.002 mg/kg. The results are shown in Table 55.

Table 52 Supervised trials conducted in the USA in 1986 with abamectin on citrus (whole fruit) (6012-172B and MK 936/0165)

Location	Crop (Variety)	Application rate, g ai/ha	DAT (days)	Residue (mg/kg)		Report; Trial
				Avermectin B_{1a} + 8,9-Z-isomer	Avermectin B_{1b} + 8,9-Z-isomer	
Clemont, FL	Grapefruit (White)	3× 28	0 7	< 0.005 (2) < 0.005 (2)	< 0.005 (2) < 0.005 (2)	6012-172B; 001-86-002R
Texas	Grapefruit (Ruby Red)	4× 28	0 1 3 7	0.006, < 0.005 (3), 0.009 < 0.005 (4) < 0.005 (4) < 0.005 (4)	not analysed	001-86-620R
		4× 56	0 1	0.008, 0.018, 0.005 (2), 0.012, 0.015 0.008, 0.010, < 0.005	not analysed	

Location	Crop (Variety)	Application rate, g ai/ha	DAT (days)	Residue (mg/kg)		Report; Trial
				Avermectin B_{1a} + 8,9-Z-isomer	Avermectin B_{1b} + 8,9-Z-isomer	
			3 7	(3) < 0.005 (4) < 0.005 (7)		
Corona, CA	Lemon	28, 28, 33	0 1 3 7	0.008, 0.006, 0.007, < 0.005 < 0.005 (4) < 0.005 (4) < 0.005 (4)	not analysed	6012-172B; 001-86-114R
		3× 56	0 1 3 7	0.014, 0.011, 0.012 (2) < 0.005 (4) < 0.005 (4) < 0.005 (4)	not analysed	
Clemont, FL	Orange (Hamilin)	3× 28	0 1 3 7 14	< 0.005 (3), 0.008, < 0.005 (4) < 0.005 (4) < 0.005 (4) < 0.005 (4)	not analysed	6012-172B; 001-86-003R
		3× 56	0 1 3 7 14	0.006, 0.007 (2), 0.010 < 0.005 (4) < 0.005 (4) < 0.005 (4) < 0.005 (4)	not analysed	
Lake County, FL	Orange (Navel)	3× 28	0 7	< 0.005 (2) < 0.005 (2)	< 0.005 (2) < 0.005 (2)	6012-172B; 001-86-061R
Arizona	Orange (Navel)	3× 28	0 7	0.005, 0.006 < 0.005 (2)	< 0.005 (2) < 0.005 (2)	6012-172B; 001-86-169R
St. Paula, CA	Orange (Valencia)	30, 35, 28	0 7	0.015, 0.016 0.008 (2)	< 0.005 (2) < 0.005 (2)	6012-172B; 001-86-196R
		61, 56, 56	0 7	0.016 (2) 0.012 (2)	< 0.005 (2) < 0.005 (2)	
		24, 26, 37	0 7	< 0.005 (2) < 0.005 (2)	< 0.005 (2) < 0.005 (2)	
		66, 56, 47	0 7	< 0.005 (2) < 0.005 (2)	< 0.005 (2) < 0.005 (2)	
Tulare, CA	Orange (Navel)	3× 28	0 7	0.011, 0.010 < 0.005 (2)	< 0.005 (2) < 0.005 (2)	6012-172B; 001-86-515R
Tulare, CA	Orange (Navel)	28, 28, 39	0 7	0.026 (2) 0.014 (0.012, 0.015)	< 0.005 (2) < 0.005 (2)	6012-172B; 001-86-596R
		3× 56	0 7	< 0.005 (2) < 0.005 (2)	< 0.005 (2) < 0.005 (2)	
		3× 28	0 7	< 0.005 (2) 0.010 (0.010, 0.011)	< 0.005 (2) < 0.005 (2)	
		3× 56	0 7	< 0.005 (2) < 0.005 (2)	< 0.005 (2) < 0.005 (2)	
Texas	Orange (Navel)	3× 28	0 7	0.006, 0.008 < 0.005 (2)	< 0.005 (2) < 0.005 (2)	6012-172B; 001-86-698R
Lake County, FL	Tangelo	3× 28	0 7	0.007 (2) < 0.005 (2)	< 0.005 (2) < 0.005 (2)	6012-172B; 001-86-062R
Lake County, FL	Tangelo	3× 28	0 7	< 0.005, 0.006 < 0.005 (2)	< 0.005 (2) < 0.005 (2)	6012-172B; 001-86-001R

Pome fruit

Forty two supervised residue trials were conducted on pome fruit (33 × apples, 7 × pears) in Europe from 1986 to 2012. Apple and pear samples were stored deep-frozen for a maximum of 24 months with exception of Study 4161, where samples were analysed after 26–37 months. Residues in pome fruit samples were analysed by HPLC-FL or LC-MS/MS. Residue data from supervised trials on pome fruits are summarized in Table 53.

Table 53 Supervised trials conducted in Europe with abamectin in pome fruits

Country year	Crop (Variety)	Application rate, g ai/ha	Growth stage	DAT, days	Residues, mg/kg			Study; trial
					Avermectin B_{1a}	8,9-Z-isomer	Avermectin B_{1b}+ 8,9-Z-isomer	
France 1991 (October)	Apple (Jonagold)	2× 27	28 days before harvest	0 7 14 21 28	0.025, 0.018 (2), 0.013 0.007, 0.011, 0.008 0.009 (2), 0.004, 0.005 0.006, < 0.002, 0.012, 0.008 0.004 (0.006, 0.002, 0.004, 0.003)	included	0.003, < 0.002 (3) < 0.002 (3) < 0.002 (4) < 0.002 (4) < 0.002 (4)	MSD 329/942555; 066-91-0016R
France 1991 (August)	Apple (Golden Delicious)	2× 27	28 days before harvest	0 28	0.006, 0.015, 0.003, 0.004 0.003 (0.003 (2), < 0.002)	included	< 0.002 (4) < 0.002 (3)	MSD 329/942555; 066-91-0017R
France 1993	Apple (Idared 106)	13, 16 (with oil)	28 days before harvest	–0 0 7 15 21 28	< 0.002 (2) 0.017, 0.013 < 0.002 (4) < 0.002 (2) < 0.002 (2) < 0.002 (2)	included	< 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2)	MSD 329/942555; 066-93-0015R
France 1993	Apple (Golden Delicious)	23, 28 (with oil)	28 days before harvest	0 28	0.010, 0.014 < 0.002 (2)	included	< 0.002 (2) < 0.002 (2)	MSD 329/942555; 066-93-0017R
France 1993	Apple (Golden Delicious)	2× 27	28 days before harvest	0 28	0.030, 0.029 0.004 (0.003, 0.005)	included	0.004 (2) < 0.002 (2)	MSD 329/942555; 066-93-0016R
France 2007	Apple (Golden)	2× 19	BBCH 79–85	–0 0 7 14 21 28	< 0.002 0.008 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	T011028-06; AF/11538/SY/2
France 2007	Apple (Fuji)	22, 20	BBCH 81–85	–0 0 7 14 21 28	< 0.002 0.010 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	T011027-06; AF/11539/SY/1
France 2009	Apple (Fuji)	21, 20	BBCH 85	–0 0 7 14 21 28	< 0.002 0.011 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	CEMS-4442; S09-01570-01
		2× 21	BBCH 85	–0 0 7 14 21 28	< 0.002 0.006 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	
France 2009	Apple (Golden)	20, 21	BBCH 76–85	–0 0 7 14 21 28	< 0.002 0.014 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	CEMS-4443; S09-01569-01
		20, 21	BBCH 76–85	–0 0 7 14 21 28	< 0.002 0.005 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	

Country year	Crop (Variety)	Application rate, g ai/ha	Growth stage	DAT, days	Residues, mg/kg			Study; trial
					Avermectin B_{1a}	8,9-Z-isomer	Avermectin B_{1b}+ 8,9-Z-isomer	
France, Louret 2012	Apple (Golden)	2× 21	BBCH 78–81	–0 0 7 14 21 28	< 0.002 0.006 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	S12-03308; S12-03308-01
France, Torraine 2012	Apple (Braeburn)	2× 20	BBCH 79–85	–0 0 7 14 22 28	< 0.002 0.004 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	S12-03308; S12-03308-02
Italy 1993	Apple (Red Chief)	2× 27	28 days before harvest	0 28	0.006, 0.007 < 0.002 (2)	included	< 0.002 (2) < 0.002 (2)	MSD 329/942555; 067-93-0007R
Italy 1993	Apple (Red Chief)	25, 27	28 days before harvest	0 28	0.015, 0.008 < 0.002 (2)	included	< 0.002 (2) < 0.002 (2)	MSD 329/942555; 067-93-0006R
Italy 2007	Apple (Imperatore)	2× 20	BBCH 81–85	–0 0 7 14 21 28	< 0.002 0.008 0.003 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	T011027-06; AF/11539/SY/2
Italy 2009	Apple (Pink Lady)	21, 20	BBCH 81–83	–0 0 7 14 21 28	< 0.002 0.012 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	CEMS-4442; S09-01570-02
		2× 21	BBCH 81–83	–0 0 7 14 21 28	< 0.002 0.017 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	
Italy, Bologne 2012	Apple (Nero red Rome)	2× 21	BBCH 78–79	–0 0 7 14 20 28	< 0.002 0.005 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	S12-03309; S12-03309-02
Italy Ferrara 2012	Apple (Golden)	21, 22	BBCH 75–77	–0 0 7 14 20 28	< 0.002 0.006 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	S12-03309; S12-03309-01
Germany 1991	Apple (Golden Delicious)	2× 27 (with oil)	28 days before harvest	0 28	0.030, 0.023, 0.021, 0.014 0.008, 0.007 (2), 0.005	included	0.003, 0.002 (2), < 0.002 < 0.002 (3), 0.002	4161; 072-91-0004R
Germany 1991	Apple (Golden Delicious Smoothee M9)	2× 27 (with oil)	28 days before harvest	0 7 14 21 28	0.026, 0.022 (2), 0.020 0.008, 0.006, 0.005, 0.009 0.007 (3), 0.003 0.007, 0.006, 0.004, 0.005 0.004 (0.005, 0.004 (3))	included	0.003 (2), 0.002 (2) < 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4)	4161; 072-91-0005R
Germany 1991	Apple (Golden	2× 27 (with oil)	28 days before	0 7	0.026, 0.031 (2), 0.027 0.009, 0.018,	included	0.002 (2), 0.003 (2)	4161; 072-91-0006R

Country year	Crop (Variety)	Application rate, g ai/ha	Growth stage	DAT, days	Residues, mg/kg Avermectin B_{1a}	8,9-Z-isomer	Avermectin B_{1b}+ 8,9-Z-isomer	Study; trial
	Delicious)		harvest	 14 22 29	0.013, 0.014 0.013 (2), 0.010, 0.007 0.008, 0.009 0.007 (0.010, 0.006 (2))		< 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002	
Germany 2007	Apple (Gloster)	2× 19	BBCH 81–85	–0 0 7 14 21 28	< 0.002 0.011 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	T011028-06; AF/11538/SY/1
Germany 2009	Apple (Elstar)	20, 21	BBCH 78–85	–0 0 7 14 21 28	< 0.002 0.014 0.003 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	CEMS-4442; S09-01569-02
		2× 21	BBCH 78–85	–0 0 7 14 21 28	< 0.002 0.014 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	
Greece, Megas Alexxandros 2012	Apple (Granny Smith)	2× 20	BBCH 77–81	–0 0 7 14 20 28	< 0.002 0.005 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	S12-03309; S12-03309-03
Greece, Giannitsa 2012	Apple (Granny Smith)	2× 20	BBCH 77–81	–0 0 7 14 20 28	< 0.002 0.003 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	S12-03309; S12-03309-04
Spain 1991	Apple (Red Delicious)	2× 27	28 days before harvest	0 28	0.013, 0.014, 0.021, 0.017 < 0.002 (4)	included	< 0.002 (3), 0.002 < 0.002 (4)	4161; 065-91-0007R
Spain 1991	Apple (Golden Delicious)	2× 27 oil	28 days before harvest	0 28	0.011, 0.012, 0.019, 0.013 0.002 (0.004, < 0.002 (3))	included	< 0.002 (4) < 0.002 (4)	4161; 065-91-0008R
Spain 1991	Apple (Red Delicious, Red Chief)	2× 27 oil	28 days before harvest	0 7 14 21 28	0.009, 0.016, 0.014, 0.011 0.002, 0.005, < 0.002, 0.003 < 0.002, 0.004, 0.003 (2) < 0.002 (3), 0.003 0.003 (< 0.002 (2), 0.004, 0.003)	included	< 0.002 (3), 0.002 < 0.002 (3), 0.002 < 0.002 (3), 0.002 < 0.002 (3), 0.002 < 0.002 (3), 0.002	4161; 065-91-0009R
Spain 1993	Apple (Golden Delicious)	26, 28	28 days before harvest	0 28	0.018, 0.012 < 0.002 (2)	included	< 0.002 (2) < 0.002 (2)	329/942555; 065-93-0006R
Spain 1993	Apple (Golden Delicious)	2× 26	28 days before harvest	0 28	0.017, 0.014 < 0.002 (2)	included	0.002, < 0.002 < 0.002 (2)	329/942555; 065-93-0007R
UK 1991	Apple (Cox's Orange Pippin)	2× 27 (with oil)	28 days before harvest	0 28	0.026, 0.019, 0.027, 0.020 0.007 (0.005, 0.005, 0.010, 0.007)	included	0.003 (2), 0.002 (2) < 0.002 (4)	4161; 074-91-0003R
UK	Apple	2× 27	28 days	0	0.035, 0.033,	included	0.003 (2), 0.004	4161; 074-

Country year	Crop (Variety)	Application rate, g ai/ha	Growth stage	DAT, days	Residues, mg/kg			Study; trial
					Avermectin B_{1a}	8,9-Z-isomer	Avermectin B_{1b}+ 8,9-Z-isomer	
1991	(Cox's Orange Pippin)	(with oil)	before harvest	 7 14 21 28	0.044, 0.043 0.009 (2), 0.010, 0.011 0.007, 0.008 (3) 0.006 (2), 0.004, 0.009 0.005 (3), 0.006		(2) < 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4)	91-0004R
UK 2012	Apple (Cox)	20, 21	BBCH 75–76	–0 0 7 14 21 27	< 0.002 0.007 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	S12-03308; S12-03308-04
UK 2012	Apple (Cox)	18, 22	BBCH 75–77	–0 0 7 14 20 28	< 0.002 0.007 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	S12-03308; S12-03308-05
France 1986	Pear (Beurre Hardy)	3× 27		0 1 3 7	0.009 < 0.005 < 0.005 (2) < 0.005 (2)	included	< 0.005 < 0.005 < 0.005 (2) < 0.005 (2)	066-86-004R
		3× 54		0 1 3 7	0.017 0.011 0.007, < 0.005 < 0.005 (2)	included	< 0.005 < 0.005 < 0.005 (2) < 0.005 (2)	
France 1986	Pear (Beurre Hardy)	3× 27		0 1 3 7	0.008 < 0.005 < 0.005 (2) < 0.005 (2)	included	< 0.005 < 0.005 < 0.005 (2) < 0.005 (2)	066-86-005R
		3× 54		0 1 3 7	0.026 0.008 0.006, < 0.005 < 0.005 (2)	included	< 0.005 < 0.005 < 0.005 (2) < 0.005 (2)	
France 1986	Pear (Doyenne du Comice)	3× 27	28 days before harvest	0 1 3 7 14 21 28	0.014 0.005 < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.005 < 0.005	included	< 0.005 < 0.005 < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.005 < 0.005	066-86-047R
Italy 1988	Pear (Guyot)	3× 27	28 days before harvest	0 1 3 7 14 21 28	0.019 0.010 < 0.005 < 0.005 < 0.005 < 0.005 < 0.005	included	< 0.005 < 0.005 < 0.005 < 0.005 < 0.005 < 0.005 < 0.005	AB-P1; 067-88-0042R
Italy 1988	Pear (Decana)	3× 27	28 days before harvest	0 3 8 10 14 21 28	0.019 (2), 0.020, 0.021 < 0.005 (2), 0.008, 0.006 < 0.005 (3), 0.006 < 0.005 (3), 0.005 < 0.005 (4) < 0.005 (4) < 0.005 (4)	included	< 0.005 (4) < 0.005 (4) < 0.005 (4) < 0.005 (4) < 0.005 (4) < 0.005 (4) < 0.005 (4)	AB-P1; 067-88-0043R
Spain 1995	Pear (Flor de Invierno)	28, 27	28 days before harvest	0 28	0.006, 0.004 < 0.002 (2)	included	< 0.002 (2) < 0.002 (2)	4586; 065-95-0006R
UK 1995	Pear (–)	2× 27	28 days before harvest	0 30	0.015, 0.021 < 0.002 (2)	included	< 0.002 (2) < 0.002 (2)	4586; 074-95-0006R

Cherries

Eighteen supervised residue trials were conducted on cherries in the USA during 1998, 1999 and 2008. Samples were analysed by HPLC/FL or LC-MS/MS (2008 trials). Cherry samples were stored deep-frozen for a maximum of 15.2 months. Residue data from supervised trials on cherry are summarized in Table 54.

Table 54 Results from supervised trials conducted in the USA with abamectin in cherries at 2× 26 g ai/ha

Location, year	Variety	Growth stage	DAT, days	Residues, mg/kg		Study; trial
				Abamectin B_{1a} + 8,9-Z-isomer	Abamectin B_{1b} + 8,9-Z-isomer	
Washington, 1998	Sweet, Bing	green fruit	21	0.008 (0.007, 0.009)	< 0.002 (2)	161-98; OW-IR-604-8/WA
Oregon, 1998	Sweet, Lambert	05 in. diam.	21	0.009 (0.007, 0.011)	< 0.002 (2)	161-98;OW-IR-605-98/OR
Fresno, CA 1998	Sweet, Bing	immature fruit	0 2 6 9 14 18 21 28	0.018, 0.022 0.019, 0.025 0.010, 0.010 0.017, 0.013 0.008, 0.006 0.004, 0.005 0.005 (0.006, 0.004) 0.002, 0.003	< 0.002, 0.002 < 0.002, 0.002 < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2)	161-98;02-IR-024-98/CA
Stanislaus, CA, 1998	Sweet, Black Tartarian	fruit set green fruit	21	0.004 (0.003, 0.004)	< 0.002 (2)	161-98;OW-IR-433-98/CA
Utah, 1998	Tart, Montmorency	green, salmon	21	0.047(0.058, 0.036)	0.007, 0.004	161-98; OW-IR-701-98/UT
			21	0.025, 0.029	0.003 (2)	
Ottawa, MI 1998	Sweet, Ulster	immature fruit	21	0.018, 0.015	< 0.002 (2)	161-98; NE-IR-706-98/MI
Ottawa, MI 1998	Tart, Montmorency	immature fruit	0 2 6 10 14 18 21 28	0.078, 0.094 0.075, 0.060 0.107, 0.044 0.044, 0.045 0.050, 0.037 0.033, 0.020 0.013, 0.028 0.018, 0.016	0.007, 0.009 0.007, 0.005 0.010, 0.005 0.005 (2) 0.005, 0.004 0.003 (2), 0.002 (2) < 0.002, 0.003 < 0.002 (2)	161-98;NE-IR-708-98/MI
Ottawa, MI 1998	Tart, Montmo-rency	immature fruit	21	0.024 (0.023, 0.024)	0.002 (2)	161-98;NE-IR-709-98/MI
Michingan, Oceana 1998	Cherry sweet (Gold)	immature fruit	21	0.016 (0.014, 0.013, 0.007, 0.007)	< 0.002 (2)	161-98; NE-IR-707-98/MI
			21	0.020, 0.014 (2)	< 0.002 (2)	
Winconsin, 1998	Tart, Galaxy	pea size red-orange	21	0.010 (2)	< 0.002 (2)	161-98;MW-IR-703-98/WI
New York, 1998	Tart, Montmo-rency	1–2.1 cm	21	0.011 (0.007 (2), 0.015)	< 0.002 (2)	161-98;NE-IR-803-98/NY
			21	0.005, 0.004, 0.007 (2)	< 0.002 (2)	
Oregon, 1999	Sweet, Bing	¾ in. diameter	21	0.003 (0.003 (2), 0.004)	< 0.002 (4)	172-99; OW-IR-610-99/OR
New York, 2008	Tart, Montmo-rency	BBCH 71–81	21	0.007 (2)	< 0.002 (2)	T005601-07; E03NY081081
Wisconsin 2008	Tart, Montmo-	not reported	21	0.015 (0.020, 0.010)	< 0.002 (2)	T005601-07; E19WI081082

Location, year	Variety	Growth stage	DAT, days	Residues, mg/kg		Study; trial
				Abamectin B_{1a} + 8,9-Z-isomer	Abamectin B_{1b} + 8,9-Z-isomer	
	rency					
Kernan, CA 2008	Sweet, Brooks	BBCH 75–85	7 14 21 28 35	0.005 0.005 0.006 (0.007, 0.004) 0.006 0.003	< 0.002 < 0.002 < 0.002 (2) < 0.002 < 0.002	T005601-07; W30CA081083
Hollister, CA 2008	Sweet, Bing	BBCH 75–85	21	0.003 (0.002, 0.004)	< 0.002 (2)	T005601-07; W27CA081084
Ephrata, WA 2008	Sweet, Bing	BBCH 69–75	21	0.005	< 0.002	T005601-07; W18WA081085
Ephrata, WA 2008	Sweet, Bing	BBCH 69–75	21	0.009 (0.008, 0.010)	< 0.002 (2)	T005601-07; W18WA081086

Peaches

Twelve supervised residue trials were conducted on peaches in Europe during 2002 and 2003. Samples were analysed by LC-MS/MS. Peach samples were stored deep-frozen for a maximum of 13 months (407 days). Seventeen supervised residue trials were conducted on peaches in the USA during 1998 and 2008. Samples were analysed either by HPLC/FL (1998 trials) or LC-MS/MS (2008 trials). Peach whole fruit samples were stored deep-frozen for a maximum of 15.2 months. Residue data from supervised trials on peaches are summarized in Table 55.

Table 55 Results from supervised trials conducted in Europe with abamectin in peaches

Country	Peach variety	Application rate, g ai/ha	Growth stage	DAT, days	Crop Part	Residues, mg/kg			Study, trial
						Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
France 2001	Dolores/GF 677	14, 13	79–81	0 0 14 14	pulp w/ fruit pulp w/ fruit	0.033 0.031 0.006 (2) 0.006 (2)	< 0.002 < 0.002 < 0.002 (2) < 0.002 (2)	0.0022 0.0021 < 0.002 (2) < 0.002 (2)	1077/01; Roquecourbe
France 2001	July lady	2× 14	79–85	0 0 14 14	pulp w/ fruit pulp w/ fruit	0.043 0.041 0.003, 0.006 0.002, 0.006	< 0.002 < 0.002 < 0.002 (2) < 0.002(2)	0.003 0.003 < 0.002 (2) < 0.002 (2)	1078/01
France 2001	Fidelia/GF 677	2× 13	78–81	0 0 3 3 7 7 10 10 14 14	pulp w/ fruit pulp w/ fruit pulp w/ fruit pulp w/ fruit pulp w/ fruit	0.036 0.031 0.018 0.016 0.006 0.005 0.003 0.003 0.003 (2) 0.003 (2)	< 0.002 < 0.002 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2) < 0.002 (2)	0.003 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2) < 0.002 (2)	1079/01; Roquecourbe

Country	Peach variety	Application rate, g ai/ha	Growth stage	DAT, days	Crop Part	Residues, mg/kg			Study, trial
						Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
France 2001	Pavie: Andross	2× 14	70–76	0 0 3 3 7 7 10 10 14 14	w/ fruit pulp pulp w/ fruit pulp w/ fruit pulp w/ fruit pulp w/ fruit	0.013 0.014 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (3)	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (3)	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (3)	1080/01 Trial: 1–Vauvert
France 2002	Symphonie	2× 20	77–78	0 0 14 14	pulp w/ fruit pulp w/ fruit	0.024 0.021 0.004 0.004	< 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002	02-1145; Twissac
France 2002	Bienvenue	20, 21	75–78	0 0 14 14	pulp w/ fruit pulp w/ fruit	0.031 0.028 0.006 0.006	< 0.002 < 0.002 < 0.002 < 0.002	0.002 < 0.002 < 0.002 < 0.002	02-1146; St. Sardos
France 2002	Royal Glori	20, 22	75–85	0 0 3 3 7 7 14 14	pulp w/ fruit pulp w/ fruit pulp w/ fruit pulp w/ fruit	0.040 0.035 0.021 0.019 0.018 0.016 0.007 0.006	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	0.003 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	02-1147; Meauzac
Italy 2002	Elegant lady	2× 21	75–77	0 0 3 3 7 7 14 14	pulp w/ fruit pulp w/ fruit pulp w/ fruit pulp w/ fruit	0.014 0.012 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	02-1148 Trial: 1–Tintoria
Italy 2003	Maria Bianca	2× 20	77–81	0 14 0 14	pulp pulp w/ fruit w/ fruit	0.010 < 0.002 0.009 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002	03-5075

Country	Peach variety	Application rate, g ai/ha	Growth stage	DAT, days	Crop Part	Residues, mg/kg			Study, trial
						Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
Italy 2003	Elegant Lady	2× 20	75–77	0 3 7 10 14 0 3 7 10 14	pulp pulp pulp pulp pulp w/ fruit w/ fruit w/ fruit w/ fruit w/ fruit	0.039 0.004 < 0.002 < 0.002 < 0.002 0.036 0.004 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	03-5076
Spain 2003	Calanda	2× 20	77–81	0 14 0 14	pulp pulp w/ fruit w/ fruit	0.019 0.006 0.018 0.006	< 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002	03-5073
Spain 2003	Carson	21, 20	74–81	0 3 7 10 14 0 3 7 10 14	pulp pulp pulp pulp pulp w/ fruit w/ fruit w/ fruit w/ fruit w/ fruit	0.032 0.015 0.010 0.006 0.005 0.029 0.014 0.009 0.006 0.005	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	03-5074
USA, GA 1998	Summer Gold	2× 26	maturing	14	w/ fruit	0.005, 0.006	included	< 0.002 (2) [a]	161-98; OW-IR-836-98/GA
USA Fresno, CA 1998	Fay Elberta	2× 26	immature	0 2 6 9 15 19 22 29	w/ fruit	0.010 (2) 0.007, 0.004 0.004, 0.006 0.006, 0.004 < 0.002, 0.006 0.003 (2), 0.002 (0.002 (3), 0.003) < 0.002 (4)	included	< 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (4) < 0.002 (4) [a]	161-98; 02-IR-023-98/CA
USA Madera, CA 1998	Camival	2× 26	small green	21	w/ fruit	< 0.002 (2)	included	< 0.002 (2) [a]	161-98; OW-IR-106-98/CA
USA Butte, CA, 1998	Loadels	2× 26	develop	21	w/ fruit	0.006 (< 0.002, 0.009)	included	< 0.002 (2) [a]	161-98; OW-IR-432-98/CA
		2× 26	develop	21	w/ fruit	0.007, < 0.002	included	< 0.002 (2) [a]	

Country	Peach variety	Application rate, g ai/ha	Growth stage	DAT, days	Crop Part	Residues, mg/kg			Study, trial
						Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
USA SC, 1998	Contender	2× 26	1.5–2 in. diam. .	21	w/ fruit	0.002 (< 0.002 (2), 0.003, 0.002)	included	< 0.002 (4) [a]	161-98; OS-IR-607-98/SC
		2× 26		21	w/ fruit	< 0.002 (4)	included	< 0.002(2) [a]	
USA NC, 1998	Bell of Georgia	2× 26	2.3 in. diam.	21	w/ fruit	< 0.002 (2)	included	< 0.002(2) [a]	161-98; OS -IR-608-98/NC
USA Michigan 1998	Elberta	2× 26	immature	21	w/ fruit	< 0.002 (2)	included	< 0.002(2) [a]	161-98; NE-IR-705-98/MI
		2× 26	immature	21	w/ fruit	0.004 (0.005, < 0.002)	included	< 0.002(2) [a]	
USA Pensilvania 1998	Redskin	2× 26	1.5–3 in. diam.	22	w/ fruit	0.005 (2)	included	< 0.002(2) [a]	161-98; NE-IR-602-98/PA
		2× 26	1.5–3 in. diam.	22	w/ fruit	0.002, 0.003	included	< 0.002(2) [a]	
USA Texas, 1998	Florida King	2× 26	ripening	14	w/ fruit	0.08, 0.020	included	< 0.002(2) [a]	161-98; OS-IR-204-98/TX
		2× 26	ripening	14 21	w/ fruit	0.038, 0.033 0.024	included	0.004, 0.003 0.002 [a]	
USA Pennsylvania 1998	Glen Glow	2× 26	3–5 cm diam.	21	w/ fruit	0.002 (< 0.002, 0.002)	included	< 0.002 (2)	T005601-07; E04PA081087
USA Montezuma, GA 2008	Flame Prince	2× 26	69–76	21	w/ fruit	0.002 (< 0.002, 0.002)	included	< 0.002(2)	T005601-07; E19GA081088
USA Montezuma, GA 2008	MarQueen	2× 26	69–76	21	w/ fruit	0.003 (< 0.002, 0.004)	included	< 0.002 (2)	T005601-07; E19GA081089
USA Montezuma, GA 2008	Faye Elberta	2× 26	69–76	21	w/ fruit	0.003, 0.002	included	< 0.002 (2)	T005601-07; E19GA081090
USA Wisconsin, 2008	Redskin	2× 26	–	21	w/ fruit	0.006 (0.006, 0.005)	included	< 0.002 (2)	T005601-07; E19WI081091
USA Madera, CA 2008	Springcrest	2× 26	73	7 14 21 28 35	w/ fruit	0.009 0.005 0.002 (2) < 0.002 < 0.002	included	< 0.002 < 0.002 < 0.002 (2) < 0.002 < 0.002	T005601-07; W29CA081093
USA, Fresno, CA 2008	Autumn Red	2× 26	75–81	21	w/ fruit	0.004 (0.004, 0.003)	included	< 0.002 (2)	T005601-07; E19CA081094
USA Sanger, CA 2008	September Sun	2× 26	75–82	21	w/ fruit	0.008 (0.009, 0.007)	included	< 0.002 (2)	T005601-07; E19CA081095

[a] Include the 8,9-Z-isomer of avermectin B_{1b}

Plums

Seventeen supervised residue trials were conducted on plums in the USA during 1996, 1997 and 2008. Samples were analysed either by HPLC-FL (1996/97 trials) or LC-MS/MS (2008 trials). Plum samples were stored deep-frozen for a maximum of 6.5 months (198 days). Residue data from supervised trials on plum are summarized in Table 56.

Table 56 Results of supervised residue trials conducted with abamectin in USA on plums

Location year	Variety	Application rate, g ai/ha	Growth Stage	DAT, days	Residue Found (mg/kg)		Study; trial
					Avermectin B_{1a}+ 8,9-Z-isomer	Avermectin B_{1b}	
Fresno, CA 1996	French	2× 27	colouring harvest	0 14 21	0.015 (2) 0.003, 0.004 0.004 (< 0.002 (2), 0.006, 0.004)	< 0.002 (2) < 0.002 (2) < 0.002 (4) [a]	ABR-98073; 001-96-4011R
Tulare, CA 1996	French Myro-29 Rootstock	2× 27	colouring mature	0 14 21	0.009, 0.012 < 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2) < 0.002 (2) [a]	ABR-98073; 001-96-4012R
Yolo, CA 1996	French Moraslin Rootstock	2× 27	immature 60% mature	0 14 21	0.015, 0.018 < 0.002 (2) 0.002 (< 0.002, 0.003)	< 0.002 (2) < 0.002 (2) < 0.00 (2) [a]	ABR-98073; 001-96-4013R
Stanislaus, CA 1996	Plum (French)	2× 27	immature near mature	0 14 21	0.011, 0.017 < 0.002, 0.005 < 0.002 (2)	< 0.002 (2) < 0.002 (2) [a]	ABR-98073; 001-96-4014R
Michigan 1997	Stanley	2× 27	immature	0 14 21	0.025, 0.018 0.005 (2) 0.004 (0.003, 0.005)	< 0.002 (2) < 0.002 (2) < 0.002 (2) [a]	ABR-98073; 01-IR-001-97
Fresno, CA 1997	Angelano	2× 27	immature–mature	0 14 21	0.010, 0.010 0.003, 0.008 0.004 (0.003, 0.005)	< 0.002 (2) < 0.002 (2) < 0.002 (2) [a]	ABR-98073; 01-IR-002-97
Fresno, CA 1997	Friar	2× 27	near maturity mature	0 14 21	0.002, < 0.002 0.003, < 0.002 < 0.002 (2)	< 0.002 (2) < 0.002 (2) < 0.002 (2) [a]	ABR-98073; 01-IR-005-97
Washington 1997	Friar	2× 27	green fruit	0 14 21	0.008, 0.012 0.009, 0.003 0.004 (< 0.002, 0.005)	< 0.002 (2) < 0.002 (2) < 0.002 (2) [a]	ABR-98073; 01-IR-003-97
Oregon 1997	Italian	2× 27	colouring to sweeten	0 14 21	0.008 (2) < 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2) < 0.002 (2) [a]	ABR-98073; 01-IR-004-97
Wisconsin, 2008	Early Golden	2× 26	-	21	0.003 (0.004, 0.002)	< 0.002 (2)	T005601-07; E19WI081096
Hughson, CA, 2008	French Plum	2× 26	77, 81	21	0.004 (0.005, 0.003)	< 0.002 (2)	T005601-07; W26CA081097
		129, 131	77, 81	21	0.010, 0.030	< 0.002 (2)	
Hickman, CA, 2008	Grand Rosa	2× 26	77 81	21	< 0.002 (2)	< 0.002 (2)	T005601-07; W26CA081098
Fresno, CA, 2008	Flavor Rich	26, 25	77 81	7 14 21 28 35	< 0.002 < 0.002 0.004 (0.005, < 0.002) < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 (2) < 0.002 < 0.002	T005601-07; W30CA081099
Kerman, CA, 2008	French Prune	2× 26	73, 77	21	< 0.002 (2)	< 0.002, < 0.002	T005601-07; W29CA081100
		2× 131	73, 77	21	0.003 (2)	< 0.002, < 0.002	
Oregon 2008	Italian	26, 27	76, 81	21	< 0.002 (2)	< 0.002, < 0.002	T005601-07; W21OR081101

[a] Includes 8,9-z isomer of avermectin B_{1b}

Raspberries

Four supervised residue trials were conducted on raspberries in Italy in 2004, two open field trials and two trials in open tunnels. Samples of raspberries were stored deep-frozen for a maximum of 7.2 months (218 days). Samples were analysed by LC-MS/MS detection, with only abamectin B_{1a}being analysed. Residue data from supervised trials on raspberries are summarized in Table 57.

Table 57 Results of supervised residue trials conducted with abamectin in on raspberry in Italy in 2004

Location, method	Raspberry variety	Application rate, g ai/ha	DAT, days	Residues, mg/kg	Study, trial
				Avermectin B_{1a}	
Pergine Valsugana, field	Eritage	20.25	7	< 0.02	AGRI 023/04 GLP HAR, GLP 011-04-sm
Frassilongo, field	Eritage	20.25	7	0.02	AGRI 023/04 GLP HAR, GLP 012-04-sm
Balsega di Pine, oppen tunnel	K Polka	20.25	0 3 7 10 14	0.10 0.02 < 0.02 < 0.02 < 0.02	AGRI 024/04 DEC, GLP 009-04-sm
Pergine Valsugana, open tunnel	Eritage	20.25	0 3 7 10 14	0.12 0.04 0.03 < 0.02 < 0.02	AGRI 024/04 DEC, AGRI 010-04-sm

Strawberries

Eight supervised residue trials were conducted on protected strawberries in Europe during 1999, 2003 and 2004. Samples of strawberries were stored deep-frozen for a maximum of 12 months. Samples were analysed by HPLC-FL or LC-MS/MS. Twenty-eight supervised residue trials were conducted on strawberries in the USA during 1988, 1989, 2007/08 and 2010, protected strawberries or on open-field strawberries. Samples of strawberries were stored deep-frozen for a maximum of 8 months. Samples of the 1988/1989 trials were analysed by HPLC-FL and samples of the 2007–2010 trials were analysed by LC-MS/MS. Residue data from supervised trials on strawberries are summarized in Table 58.

Table 58 Results of supervised residue trials conducted with abamectin on strawberries in Europe and the USA under protected or field conditions

Country, year	Strawberry variety	Application rate, g ai/ha	DAT, days	Residues, mg/kg			Study; trial
				Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
France, protected 1999	Selva	22, 23, 22	3	0.071 (0.069, 0.073)	included	0.003, 0.003 [a]	0030501; Fontaines de Sologne
France protected 1999	Selva	3× 22	3	0.020 (0.022, 0.018)	included	< 0.002 (2) [a]	0030502 Cheverny
France, protected 1999	Selva	23, 23, 24	0 1 2 3	0.072 0.057 0.041 0.045	included included included included	0.003 0.002 0.002 0.002 [a]	0030401 Courmemin

Country, year	Strawberry variety	Application rate, g ai/ha	DAT, days	Residues, mg/kg			Study; trial
				Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
France, protected 2003	Diamante	23, 24, 23	0 1 3 7 9	0.029 0.020 0.014 0.010 0.008	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	0.002 < 0.002 0.002 < 0.002 < 0.002	03-5066
France protected 2004	Guariguette	24, 22, 23	0 1 3 8 10	0.054 0.045 0.034 0.023 0.017	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	0.003 0.002 < 0.002 < 0.002 < 0.002	03-5085
France, protected 2004	Campsas	3× 23	0 1 3 7 10	0.068 0.048 0.042 0.024 0.019	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	0.004 0.002 0.002 < 0.002 < 0.002	03-5086
Spain, protected 1999	Camarosa	4× 22	0 0 3	0.040 0.036 0.006 (0.005, 0.006)	< 0.002 < 0.002 < 0.002 (2)	0.002 0.002 < 0.002 (2)	1112/99 Bonares
Spain, protected 1999	Camarosa	4× 22	0 3	0.038, 0.039 0.004 (2)	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	1113/99 Palos de la Frontera
USA Protected 1988	Chandler	4× 22	0 1 2 3 7	0.010 (2), 0.012, 0.018 0.014, 0.011 (2), 0.015 0.008, 0.009, 0.010, 0.011 0.007 (0.006, 0.008 (2), 0.005) < 0.005 (3), < 0.002	included	< 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4) [a]	618.936 FSS; 001-88-1027R
		4× 45	0 1 2 3 7	0.045, 0.049 0.036, 0.039 0.046, 0.045 (2), 0.033 0.033 (2), 0.042, 0.027 0.024, 0.021 (2), 0.019 0.015, 0.010, 0.007, 0.009	included	< 0.005 (4) < 0.005 (4) < 0.005 (4) < 0.005 (4) < 0.002 (4) [a]	
USA, Protected 1988	Pajaro	4× 22	0 1 2 3 7	0.024, 0.022 (2), 0.025 0.016, 0.015, 0.013, 0.012 0.008 (2), 0.012, 0.010 0.006 (< 0.002, 0.008 (3)) < 0.005 (4)	included	< 0.005 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4) [a]	618.936 FSS; 001-88-6020R
		4× 45	0 1 2 3 7	0.045, 0.053 0.047, 0.041 0.040, 0.029 0.037, 0.034 0.022, 0.020 (2), 0.019 0.020, 0.025, 0.026, 0.023 0.006, 0.007 (2), < 0.005	included	0.0050, 0.0051 < 0.005 (4) < 0.005 (4) < 0.005 (4) < 0.002 (4) [a]	
USA, protected 1988	Selva	4× 22	0 3	0.013, 0.015 0.012, 0.010 0.008 (0.005, 0.012	included	< 0.002 (4) < 0.002 (4)	618.936 FSS; 001-88-6021R

Country, year	Strawberry variety	Application rate, g ai/ha	DAT, days	Residues, mg/kg			Study; trial
				Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
				0.009, 0.006)			
USA, protected 1989	Chandler	4× 21	0 2 3	0.018 (2), 0.022 0.017, 0.019, 0.020, 0.014, 0.015 0.008 (3), 0.007 (2), 0.006 (2), 0.010 0.005 (< 0.005 (2), 0.006 (3), 0.005 (2), 0.008)	included	< 0.005, < 0.002 (7) < 0.002 (8) < 0.002 (8) [a]	618.936 FSS; 001-89-1007R
USA, protected 1989	Selva	4× 22	0 2 3	0.008, 0.009 0.006 (2) < 0.005 (4) 0.005 (< 0.005 (3), 0.0052)	included	< 0.002 (4) < 0.002 (4) < 0.002 (4) [a]	618.936 FSS; 001-89-6003R
USA, San Diego, CA field 1988	Douglas	4× 22	0 1 2 3 7	0.020, 0.015 0.016, 0.018 0.018, 0.012 0.008 (2) 0.009 (2), 0.006 (2) 0.006 (< 0.005 (2), 0.006, 0.009) < 0.005(2), < 0.002 (2)	included	< 0.002 (4) < 0.005, < 0.002 (3) < 0.002 (4) < 0.002 (4) < 0.002 (4) [a]	618.936 FSS; 001-88-1026R
		4× 45	0 1 2 3 7	0.049 (2), 0.048 0.038 0.024, 0.044 0.040, 0.039 0.035, 0.025 0.020, 0.027 0.015 (2), 0.018, 0.022 0.006, 0.007 (2), 0.009	included	0.005 (2), < 0.005 (2) < 0.005 (4) < 0.005 (2), < 0.002 (2) < 0.002 (3), < 0.005 < 0.002 (4) *	
USA, Hillsborough, FL field 1989	Pajaro	4× 22	0 3	0.031 (2), 0.024 0.026 0.006 (0.006 (3), 0.007)	included	< 0.005 (4) < 0.002 (4) [a]	618.936 FSS; 001-89-0004R
		4× 45	0 3	0.057, 0.079 0.076, 0.068 0.021, 0.017 0.008, 0.020	included	0.007, 0.010, 0.009, 0.008 < 0.005 (2), < 0.002 (2) [a]	
USA, Hillsborough, FL field 1989	Selva (large)	4× 22	0 3	0.032, 0.024 0.030, 0.036 0.006 (0.006, 0.005 0.008, 0.006)	included	< 0.005 (4) < 0.002 (4) [a]	618.936 FSS; 001-89-0005R
		4× 45	0 3	0.063, 0.052 0.057, 0.071 0.017, 0.010 0.021, 0.018	included	0.009, 0.007 0.008, 0.010 < 0.002 (2), < 0.005 (2) [a]	
USA, Hillsborough, FL field 1989	Selva	4× 22	0 2 3	0.014 (2), 0.025, 0.015 < 0.005 (8) < 0.005 (8)	included	< 0.005 (2) < 0.005 (2) < 0.005 (8), < 0.005 (8) [a]	618.936 FSS; 001-89-0024R
USA, Berrien, MI field 1989	All Star	5× 22	0 2 3	0.0050, < 0.005 (3) < 0.005 (4) < 0.005 (4)	included	< 0.005 (4) < 0.005 (4) < 0.005 (4) [a]	618.936 FSS; 001-89-1018R
USA, Berrien,	Jewell	5× 22	0	< 0.005 (2)	included	< 0.005 (4)	618.936 FSS;

Country, year	Strawberry variety	Application rate, g ai/ha	DAT, days	Residues, mg/kg			Study; trial
				Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
MI field 1989			 2 3	0.006, 0.012 < 0.005 (4) < 0.005 (4)		 < 0.005 (4) < 0.005 (4) [a]	001-89-1019R
USA, Washington, OR field 1989	Benton	4× 22	0 2 3	0.024, 0.025 0.028, 0.029 0.014, 0.012 0.008, 0.014 0.009 (0.011, 0.008 (3))	included	< 0.005 (4) < 0.005 (4), < 0.005 (4) [a]	618.936 FSS; 001-89-1020R
USA, Marion, OR field 1989	Benton	2× 22	0 2 3	0.006 (3), 0.011, < 0.005 (4) < 0.005 (2)	included	< 0.005 (4) < 0.005 (4) < 0.005 (4) [a]	618.936 FSS; 001-89-1021R
USA, Lehigh, PA field 1989	Earliglow	4× 22	0 2 3	0.007, 0.010 0.014, 0.013 < 0.005 (4) < 0.005 (4)	included	< 0.005 (4) < 0.005 (4) < 0.005 (4) [a]	618.936 FSS; 001-89-3004R
USA, Lehigh, PA field 1989	Guardian	4× 22	0 2 3	0.008 (2), 0.015, 0.013 < 0.005 (4) < 0.005 (4)	included	< 0.005 (4) < 0.005 (4) < 0.005 (4) [a]	618.936 FSS; 001-89-3005R
USA, PA field 2008	Allstar	4× 21	3	0.009 (0.010, 0.008)	included	< 0.002 (2)	T001870-07; E04PA078370
USA, FL field 2008	Camerosa	4× 21	3	0.010 (0.013, 0.008)	included	< 0.002 (2)	T001870-07; E14FL078371
USA, MI field 2008	Annapolis	4× 22	3	0.016 (0.009, 0.011, 0.015, 0.031)	included	< 0.002 (3), 0.003	T001870-07; C01MI078372
USA, Sta Maria, CA field 2007/08	Albion	2× 21 2× 22	0 1 3 5	0.16 0.046 0.026 (0.023, 0.034, 0.032, 0.020, 0.024, 0.025) 0.020	included	0.012 0.004 0.002 (2), 0.003 (3), < 0.002 < 0.002	T001870-07; W27CA078373
USA, Aromas, CA field 2007	Raritan	4× 21	3	0.028 (0.020, 0.030, 0.036, 0.026, 0.028, 0.027)	included	< 0.002 (2), 0.003 (3), 0.004	T001870-07; W27CA078374
USA, OR field2008	Selva	4× 21	3	0.006 (0.004, 0.009)	included	< 0.002 (2)	T001870-07; W21OR078375
USA, NC field 2010	Camino Real	4× 21	3	0.020 (2)	included	< 0.002 (2)	T001870-07; E10-0001
USA, CA field 2010	Albion	4× 21	3	0.010 (2)	included	< 0.002 (2)	T001870-07; W33-0002

[a] Includes the 8,9-z isomer of avermectin B_{1b}

Grapes

Twenty-four supervised residue trials were conducted on grapes in the USA during 1994, 1995 and 2008. Samples of grapes were stored deep-frozen for a maximum of ≤ 28 months. Samples were analysed using method 936-94-4, method M-073.1 and/or Meth-192, rev.2. Residue data from supervised trials on grapes are summarized in Table 62.

Table 59 Results of supervised residue trials conducted with abamectin in USA on grapes

Region Year	Grape variety	Application rate, g ai/ha	DAT, days	Residues, mg/kg		Study; trial
				Avermectin B_{1a} + 8,9-Z-isomer	Avermectin B_{1b}	
Coachela, CA 1994	T	2× 21	0 7 14 28 42	0.043, 0.030 0.007, 0.010 0.003, 0.010 0.004 (0.005, 0.004) 0.003, 0.004	0.005, 0.003 < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) [a]	618-244-94036; 001-94-1009R
Granger, WA 1994	White Reisling	22, 21	0 7 14 28 42	0.022, 0.039 0.004, 0.003 0.003, 0.002 0.002 (0.002, < 0.002) 0.002, < 0.002	0.002, 0.004 < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) [a]	618-244-94036; 001-94-1010R
Phelps, NY 1994	Catawba	21, 22	0 7 14 28 42	0.041, 0.047 0.003 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2)	0.005 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) [a]	618-244-94036; 001-94-2002R
Comstock Park, MI 1994	Concord	2× 21	0 7 14 28 42	0.038, 0.036 < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2)	0.004 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) [a]	618-244-94036; 001-94-2003R
Ceres, CA 1994	French Columbard	2× 21	0 7 14 28 42	0.018, 0.024 0.004 0.004, 0.006 0.006 (0.005, 0.007) 0.006, 0.005	0.002, 0.003 < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) [a]	618-244-94036; 001-94-5004R
Biola, CA 1994	T	2× 21	0 7 14 25 28 42	0.020, 0.023 0.005, 0.007 0.004 (2) 0.010 0.002 (0.003, < 0.002) < 0.002 (2)	0.002 (2) < 0.002 (2)) < 0.002 (2) < 0.002 < 0.002 (2) < 0.002 (2)	618-244-94036; 001-94-5006R
Georg, WA 1995	Reisling	2× 21	0 28	0.021 (2) < 0.002 (2)	0.002 (2) < 0.002 (2) [a]	618-244-94036; 001-95-1005R
Orefield, PA 1995	Niagara	2× 21	0 28	0.016, 0.029 < 0.002 (2)	0.002, 0.003 < 0.002 (2) [a]	618-244-94036; 001-95-2008R
Lodi, CA 1995	Flame Tokay	21, 20	0 28	0.029, 0.015 < 0.002 (2)	0.003, < 0.002 < 0.002 (2) [a]	618-244-94036; 001-95-5003R
Calistoga, CA 1995	Cabenet Sauvignon	2× 21	0 28	0.016, 0.014 < 0.002 (4)	< 0.002 (2) < 0.002 (2) [a]	618-244-94036; 001-95-5009R
Gonzales, CA 1995	Chardonnay	2× 21	0 28	0.043, 0.057 0.002 (< 0.002, 0.003)	0.006, 0.004 < 0.002 (2) [a]	618-244-94036; 001-95-5010R
Biola, CA 1995	Thompson Seedless	2× 21	0 28	0.034, 0.025 < 0.002 (2)	0.004, 0.003 < 0.002 (2) [a]	618-244-94036; 001-95-5011R
Escalon, CA 1995	Carignane	2× 21	0 28	0.008, 0.009 < 0.002 (2)	< 0.002 (2) < 0.002 (2) [a]	618-244-94036; 001-95-5025R
Dundee, NY 2008	Concord	2× 22	28	< 0.002 (2)	< 0.002 (2)	T005598-07; E03NY081041
		2× 107	28 28	0.006, 0.010 0.005, 0.007, 0.004	< 0.002 (2) < 0.002 (3)	
Dundee, NY	Concord	21, 22	28	< 0.002 (2)	< 0.002 (2)	T005598-07;

Region Year	Grape variety	Application rate, g ai/ha	DAT, days	Residues, mg/kg		Study; trial
				Avermectin B_{1a} + 8,9-Z-isomer	Avermectin B_{1b}	
2008						E03NY081042
Hugson, CA 2008	Thompson Seedless	21, 22	28	<u>0.004</u> (0.003, 0.004)	< 0.002 (2)	T005598-07; W26CA081043
		106, 108	28 28	0.044, 0.069 0.043, 0.052, 0.043	< 0.002 (2) < 0.002 (2), 0.002	
Madera, CA 2008	Thompson Seedless	22, 21	14 21 28 32 35	0.007 0.004 0.003 (3) <u>0.004</u> < 0.002	< 0.002 < 0.002 < 0.002 (2) < 0.002 < 0.002	T005598-07; W29CA081044
Fresno, CA 2008	Merlot	2× 21	28	< 0.002 (2)	< 0.002 (2)	T005598-07; E19CA081045
Fresno, CA 2008	Cabernet Sauvignon	22, 21	28	<u>0.002</u> (0.002, < 0.002)	< 0.002 (2)	T005598-07; E19CA081046
Selma, CA 2008	Ruby Reds	2× 21	28	< 0.002 (2)	< 0.002 (2)	T005598-07; E19CA081047
Ephrata, WA 2008	Riesling	2× 21	28	0.003, < 0.002	< 0.002 (2)	T005598-07; W18WA081048
Ephrata, WA 2008	Chardonnay	2× 21	28	<u>0.006</u> (0.003, 0.010)	< 0.002 (2)	T005598-07; W18WA081049

[a] Includes the 8,9-z isomer of avermectin B_{1b}

Avocadoes

Five supervised residue trials were conducted on <u>avocadoes</u> in the USA during 1999. Avocado samples were stored deep-frozen for a maximum of 3.8 months (116 days) and analysed by HPLC-FL. Residue data from supervised trials on avocado are summarized in Table 60.

Table 60 Results from supervised trials conducted with abamectin on avocadoes in USA (Study 871-99)

Location	Avocado variety	Application rate, g ai/ha	DAT, days	Residues, mg/kg		Trial
				Avermectin B_{1a} + 8,9-Z-isomer	Avermectin B_{1b} + 8,9-Z-isomer	
Santa Paula, CA	Hass	27, 28	14	<u>0.004</u> (0.003, 0.006)	< 0.002 (2)	07198.99-CA120
Fallbrook, CA	Hass	26, 28	14	<u>0.004</u> (< 0.002, 0.005)	< 0.002 (2)	07198.99-CA121
Valley Center, CA	Hass	26, 28	14	0.003 (2)	< 0.002 (2)	07198.99-CA122
Via Vaquero, CA	Hass	27, 25	14	<u>0.007</u> (0.009, 0.005)	< 0.002 (2)	07198.99-CA135
Florida	Peterson	26, 27	14	< 0.002 (2)	< 0.002 (2)	07198.99-FL50

Mangoes

Five supervised residue trials were conducted on <u>mangoes</u> in Brazil during 2008/09 and 2009/10. Samples were stored deep-frozen for a maximum of 21 months and analysed by either HPLC-FL or LC-MS/MS. Residue data from supervised trials on mango are summarized in Table 61.

Table 61 Results from supervised trials conducted with abamectin on mangoes in Brazil 2008–2010

Location year	Mango variety	Application rate, g ai/ha	Growth stage BBCH	DAT, days	Residues, mg/kg			Study; trial
					Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
RN, Mossoro 2008/2009	Tommy	4× 14	73–81	3 7 10	< 0.004 <u>< 0.004</u> < 0.004	included	< 0.0003 < 0.0003 < 0.00023	M09026; LZF
Minas Gerais 2009/2010	Palmer	4× 14	77- 87	3 7	0.003 0.003	< 0.002 < 0.002	< 0.001 < 0.001	M10046; LZF1

Location year	Mango variety	Application rate, g ai/ha	Growth stage BBCH	DAT, days	Residues, mg/kg			Study; trial
					Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
				10	<u>0.004</u>	< 0.002	< 0.001	
RN, Mossoro 2009/2010	Tommy	4× 14	73–81	3 7 10	0.003 <u>< 0.002</u> < 0.002	< 0.002 < 0.002 < 0.002	< 0.001 < 0.001 < 0.001	M10046; -LZF2
RN, Barauna 2009/2010	Tommy Atkins	4× 14	73–81	3 7 10	0.003 <u>< 0.002</u> < 0.002	< 0.002 < 0.002 < 0.002	< 0.001 < 0.001 < 0.001	M10046; -LZF3
Sao Paulo 2009/2010	Palmer	4× 14	79–81	3 7 10	0.005 <u>< 0.002</u> < 0.002	< 0.002 < 0.002 < 0.002	< 0.001 < 0.001 < 0.001	M10046 -AMA

Papaya

Twelve supervised residue trials were conducted on <u>papaya</u> in Brazil during the growing seasons 2002, 2009/10 and 2011/12. Papaya (fruit) samples were stored deep-frozen for a maximum of 23 months and analysed by LC-MS/MS. Residue data from supervised trials on papaya are summarized in Table 62.

Table 62 Results from supervised trials conducted with abamectin on papaya in Brazil 2008/2009

Location, year	Papaya variety	Application rate, g ai/ha	Growth stage BBCH	DAT, days	Crop Part	Residues, mg/kg			Study; trial
						Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
Linhares, ES 2002	Golden	2x23, 22, 24	61–89	0 3 3 3 7 7 7 10 10 10 14 14 14	Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit	0.028 0.031, 0.024 < 0.002 (2) 0.009, 0.011 0.016, 0.021 < 0.002 (2) 0.006, 0.007 0.011 < 0.002 0.004 0.009 <u>< 0.002</u> <u>0.004</u>	< 0.002 0.004 (2) < 0.002 (2) 0.002 (2) < 0.002, 0.004 < 0.002 (2) < 0.002 (2) 0.002 < 0.002 < 0.002 0.002 < 0.002 < 0.002	0.002 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002, 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	02-1057
		46, 43, 44, 47	61–89	0 3 3 3 7 7 7 10 10 10 14 14 14	Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit	0.041 0.060, 0.065 0.002, < 0.002 0.020, 0.022 0.038, 0.039 < 0.002 (2) 0.014 (2) 0.029 < 0.002 0.010 0.024 < 0.002 0.009	0.002 0.006, 0.008 < 0.002 (2) 0.003 (2) 0.006 (2) < 0.002 (2) 0.003 (2) 0.005 < 0.002 0.0024 0.0061 < 0.002 0.0027	0.003 0.004 (2) < 0.002 (2) 0.002 (2) 0.003 (2) < 0.002 (2) < 0.002 (2) 0.0020 < 0.002 < 0.002 0.0020 < 0.002 < 0.002	
Itamara-ju, BA 2002	Golden	23, 22, 22, 22	61–89	0 3 3 3 7 7 7 10	Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit *Peel* *Pulp*	0.014 0.013, 0.011 < 0.002 (2) 0.005, 0.004 0.009 (2) < 0.002 (2) 0.004 (2) 0.005	< 0.002 0.002 (2) < 0.002 (2) < 0.002 (2) 0.002 (2) < 0.002 (2) < 0.002 (2) 0.002	< 0.002 < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002	02-1058

Location, year	Papaya variety	Application rate, g ai/ha	Growth stage BBCH	DAT, days	Crop Part	Residues, mg/kg Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	Study; trial
				10 10 14 14 14	Fruit *Peel* *Pulp* Fruit	< 0.002 0.002 0.006 < 0.002 0.003	< 0.002 < 0.002 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	
		46, 45, 47, 44	61–89	0 3 3 3 7 7 7 10 10 10 14 14 14	Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit	0.038 0.019, 0.017 < 0.002 (2) 0.007, 0.006 0.023, 0.017 < 0.002 (2) 0.008, 0.006 0.014 < 0.002 0.005 0.011 < 0.002 0.004	0.002 0.004, 0.003 < 0.002 (2) 0.002, < 0.002 0.005, 0.004 < 0.002 (2) 0.002, < 0.002 0.005 < 0.002 0.002 0.004 < 0.002 < 0.002	0.003 0.002, < 0.002 < 0.002 (2) < 0.002 (2) 0.002, < 0.002 < 0.002, 0.002 < 0.002 (2) < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	
Pinheiros, ES2002	Taiwan	22, 24, 21, 23	61–89	0 3 3 3 7 7 7 10 10 10 14 14 14	Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit	0.011 0.014, 0.016 < 0.002 (2) 0.005 (2) 0.007, 0.006 < 0.002 (2) 0.003 (2) 0.005 < 0.002 0.002 0.005 < 0.002 0.002	< 0.002 0.003 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	02-1059
		44, 46, 44, 46	61–89	0 3 3 3 7 7 7 10 10 10 14 14 14	Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit	0.030 0.043, 0.036 < 0.002 (2) 0.013, 0.011 0.029, 0.033 < 0.002 (2) 0.008, 0.009 0.014 < 0.002 0.005 0.009 < 0.002 0.003	0.003 0.008, 0.007 < 0.002 (2) 0.003 (2) 0.006 (2) < 0.002 (2) 0.002 (2) 0.003 < 0.002 < 0.002 0.003 < 0.002 < 0.002	0.002 0.003 (2) < 0.002 (2) < 0.002 (2) 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	
Aracru, ES 2002	Golden	21, 22, 22, 24	61–89	0 3 3 3 7 7 7 10 10 10 14 14 14	Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit	0.008 0.005, 0.006 < 0.002 (2) 0.002, 0.003 0.003 (2) < 0.002 (2) < 0.002 (2) 0.003 < 0.002 < 0.002 0.0024 < 0.002 < 0.002	< 0.002 < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2)	< 0.002 < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2)	02-1060

Location, year	Papaya variety	Application rate, g ai/ha	Growth stage BBCH	DAT, days	Crop Part	Residues, mg/kg			Study; trial
						Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
		44, 41, 44, 45	61–89	0 3 3 3 7 7 7 10 10 10 14 14 14	Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit *Peel* *Pulp* Fruit	0.018 0.015, 0.017 < 0.002 (2) 0.006 (2) 0.009 (2) < 0.002 (2) 0.004 (2) 0.009 < 0.002 0.004 0.007 < 0.002 0.003	0.002 0.004 (2) < 0.002 (2) 0.002 (2) 0.003 (2) < 0.002 (2) < 0.002 (2) 0.004 < 0.002 < 0.002 0.004 < 0.002 < 0.002	< 0.002 < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2)	
Sooretama, ES 2010	Golden	3× 22	51–84	0 0 3 3 5 5 7 7 10 10 14 14	*Pulp* Fruit *Pulp* Fruit *Pulp* Fruit *Pulp* Fruit *Pulp* Fruit *Pulp* Fruit	< 0.002 0.043 < 0.002 0.020 < 0.002 0.014 < 0.002 0.010 < 0.002 0.010 < 0.002 0.008	< 0.002 0.006 < 0.002 0.006 < 0.002 0.005 < 0.002 0.004 < 0.002 0.005 < 0.002 0.004	< 0.001 0.005 < 0.001 0.003 < 0.001 0.002 < 0.001 < 0.001 < 0.001 < 0.001 < 0.001 < 0.001	M10044; LZF1
Linhares, ES 2009/10	Golden	3× 22	51–84	0 0 3 3 5 5 7 7 10 10 14 14	*Pulp* Fruit *Pulp* Fruit *Pulp* Fruit *Pulp* Fruit *Pulp* Fruit *Pulp* Fruit	< 0.002 0.020 < 0.002 0.011 < 0.002 0.008 < 0.002 0.007 < 0.002 0.008 < 0.002 0.005	< 0.002 0.004 < 0.002 0.004 < 0.002 0.003 < 0.002 0.003 < 0.002 0.003 < 0.002 0.003	< 0.001 0.002 < 0.001 0.002 < 0.001 < 0.001 < 0.001 < 0.001 < 0.001 < 0.001 < 0.001 < 0.001	M10044; LZF2
Linhares, ES 2011/12	Golden	3× 22	71–81	0 3 5 7 10 14	Fruit	0.011 0.005 0.003 0.003 0.003 0.003	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.001 < 0.001 < 0.001 < 0.001 < 0.001 < 0.001	M12047; MFG1
Jaguaré, ES 2011/12	Golden	3× 22	71–81	0 3 5 7 10 14	Fruit	0.027 0.009 0.009 0.007 0.006 0.005	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	0.003 < 0.001 < 0.001 < 0.001 < 0.001 < 0.001	M12047; MFG2

Bulb vegetables

Onions

Eight supervised residue trials were conducted on onions in the USA during 2000 to 2001. Onion bulb samples were stored deep-frozen for a maximum of 7 months and analysed by HPLC-FL. Summaries of the trial results are given in Table 63.

Table 63 Results from supervised trials conducted abamectin on onion bulbs in the USA in 2000/2001 (Study 07237)

Region	Onion variety	Application rate, g ai/ha	Growth Stage	DAT, days	Residue Found (mg/kg)			Trial
					Avermectin B_{1a}+ 8,9-Z-isomer	Avermectin B_{1b}+ 8,9-Z-isomer	Total residue	
California	Texas Grano Dry	22, 22, 21, 21	vegetative	30	< 0.002 (2)	< 0.002 (2)	< 0.004	00-CA69
Colorado	Teton	3× 21	vegetative	31	< 0.002 (2)	< 0.002 (2)	< 0.004	: 00-CO08
New Mexico	Starlite	22, 21, 21	Pre-bloom 8–10 leaves	29	< 0.002 (2)	< 0.002 (2)	< 0.004	00-NM12
New York	Quantum	22, 22, 23	6–8 leaves vegetative	29	<u>0.02</u> (0.003, < 0.002)	< 0.002 (2)	0.004	00-NY02
Ohio	Burgos	21, 22, 22	vegetative	29	< 0.002 (2)	< 0.002 (2)	< 0.004	00-OH*03
Oregon	Santos Fl	3× 21	early maturity	29	< 0.002 (2)	< 0.002 (2)	< 0.004	00-OR14
Texas	Texas Early White	3× 22	1–3 in. diameter	31	< 0.002 (2)	< 0.002 (2)	< 0.004	00-TX07
Washingt on	Salem	21, 22, 22	vegetative —bulbing	29	< 0.002 (2)	< 0.002 (2)	< 0.004	00-WA*02

Leeks

Twelve supervised residue trials were conducted on <u>leeks</u> in Europe during 2000 to 2002. In all the trials, whole plant samples were analysed by LC-MS/MS) Leek samples were stored deep-frozen for a maximum of 11 months. Summaries of the trial results are given in Table 64.

Table 64 Results from supervised trials conducted with abamectin on leeks in Europe from 2000–2002

Country (year)	Leek variet y	Applica tion rate, g ai/ha	Growth Stage	DAT, days	Residue Found (mg/kg)			Study; trial
					Avermectin B_{1a}	Avermect in B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
France 2000	Porwi tt	4× 9	BBCH 43–47	0 7	0.013 <u>< 0.002</u> (2)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	0032201 Darvoy
France 2000	Alban a	4× 9	BBCH 43–47	0 3 5 7 10	0.033 < 0.002 < 0.002 <u>< 0.002</u> (2) < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 (2) < 0.002	0.002 < 0.002 < 0.002 < 0.002 (2) < 0.002	0032301 St Benoit sur Loire
France 2000	Azur	4× 9	BBCH 43–49	0 7	0.085 <u>< 0.002</u> (2)	< 0.002 < 0.002 (2)	0.004 < 0.002 (2)	0032202 Marsillargues
France 2000	Amou ndo	4× 9	BBCH 19–45	0 3 5 7 10	0.019 < 0.002 < 0.002 <u>< 0.002</u> (2) < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 (2) < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 (2) < 0.002	0032302; St. Alban
France 2001	Schelt on	4× 9	BBCH 401–408	0 7	0.024 <u>< 0.002</u> (2)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	1069/01; Maslives
France 2001	Géant d'hive r	4× 9	BBCH 41–47	0 7	0.155 <u>0.002</u> (0.003, < 0.002)	0.002 < 0.002 (2)	0.010 < 0.002 (2)	1070/01 Crest

Country (year)	Leek variety	Application rate, g ai/ha	Growth Stage	DAT, days	Residue Found (mg/kg)			Study; trial
					Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
France 2001	Ginka	8 + 3× 9	BBCH 41–47	0 3 5 7 10	0.049 0.002 < 0.002 < 0.002 (2) < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 (2) < 0.002	0.005 < 0.002 < 0.002 < 0.002 (2) < 0.002	1071/01; Labergement les Auxonne
France 2001	Meridor	2× 10 2× 10	BBCH 42–46	0 3 5 7 10	0.073 0.002 < 0.002 < 0.002 (2) < 0.002	0.002 < 0.002 < 0.002 < 0.002 (2) < 0.002	0.005 < 0.002 < 0.002 < 0.002 (2) < 0.002	1072/01; Mauguio
Netherlands 2000	Alesia	4× 10	BBCH 43 - 48	0 7	0.016 < 0.002 (2)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	1119/00 Limburg
Netherlands 2000	Davina	4× 10	BBCH 43- 48	0 3 7 10 14	0.014 0.006 0.002 (2) < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 (2) < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 (2) < 0.002 < 0.002	1120/00 Elst
Netherlands 2001	Schelton	4× 9	50 cm	0 7	0.017 < 0.002 (2)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	1022/01; Etten Leur
Netherlands 2001	Roxton	10, 10, 9, 9	40 -60 cm	0 3 5 7 10	0.024 0.002 < 0.002 < 0.002 (2) < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 (2) < 0.002	0.002 < 0.002 < 0.002 < 0.002 (2) < 0.002	1021/01; TM Oud Gastel

Cucumber

Twenty nine supervised trials were carried out on protected cucumbers and gherkins in 1989–2002 and 2012 in Europe. Samples were stored deep-frozen for a maximum of 21 months and analysed by either by LC-MS/MS or HPLC-FL. Summaries of the trial results are given in Table 65.

Table 65 Results from protected supervised trials conducted with abamectin on cucumber and gherkins (two trials) in Europe

Country (year)	Cucumber variety	Application rate, g ai/ha	Growth stage BBCH	DAT, days	Residue Found (mg/kg)			Study; trial
					Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
France 1991	Girola	4× 22	–	0 3 7	< 0.005 (2), 0.007, 0.005 < 0.005 (4) < 0.005 (4)	included	< 0.005 (4) < 0.005 (4) < 0.005 (4) [a]	HWI 6012/378; 066-91-0008R
France 1991	Vitalis	4× 22	–	0 3 7	< 0.009, 0.013, 0.008 (2) < 0.005 (4) < 0.005 (4)	included	< 0.005 (4) < 0.005 (4) < 0.005 (4) [a]	HWI 6012/378; 066-91-0009R

Country (year)	Cucumber variety	Application rate, g ai/ha	Growth stage BBCH	DAT, days	Residue Found (mg/kg)			Study; trial
					Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
France 1991	Corona	4× 22	–	0 3 7	0.041, 0.035, 0.027, 0.036 0.025 (0.025, 0.026, 0.021, 0.029) 0.021, 0.014, 0.012 (2)	included	0.005, < 0.005 (3) < 0.005 (4) < 0.005 (4) [a]	HWI 6012/378; 066-91-0010R
Greece 2001	Aris	4× 21	61–89	0 3	0.012 0.004 (0.005, 0.002)	0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	1053/01; Kenourigio Locridos
Greece 2001	Deltastar	4× 21	61–89	0 3	0.006 < 0.005 (2)	< 0.002 < 0.002 (2)	0.002 < 0.002 (2)	1054/01; Kenourigio Locridos
Italy 1991	Darina	5× 22	–	0 3 7	< 0.005 (2) < 0.005 (2) < 0.005 (2)	included	< 0.005 (2) < 0.005 (2) < 0.005 (2) [a]	HWI-6012-374; 067-91-0001R
Italy 1991	Sprint F	5× 22	–	0 3 7	< 0.005 (2) < 0.005 (2) < 0.005 (2)	included	< 0.005 (2) < 0.005 (2) < 0.005 (2) [a]	HWI 6012-358; 067-91-0017R
Italy 2002	Akito	4× 22	64–71	–0 0 1 3 7	< 0.005 0.008 0.003 0.002 < 0.005	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	02-1144; Cerasolo ausa
Netherlands 1989	Corona	4× 22	–	0 1 3 7	0.013, 0.012, 0.011, 0.016 0.010, 0.008, 0.007, 0.011 0.007 (0.007 (2), 0.008, 0.006) 0.005, < 0.005 (3)	included	< 0.005 (4) < 0.005 (4) < 0.005 (4) < 0.005 (4) [a]	HLA-6012-322; 070-89-011R
Netherlands 1989	Ventura	4× 22	–	0 1 3 7	0.012, 0.009 (2), 0.008 0.010 (2), 0.008, 0.006 0.006 (0.007, < 0.005 (2), 0.006) < 0.005 (4)	included	< 0.005 (4) < 0.005 (4) < 0.005 (4) < 0.005 (4) [a]	HLA-6012-322; 070-89-012R
Netherlands 1990	Gherkin (Osiris)	5× 22	NR	0 1 3 7	< 0.005 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4)	included	< 0.005 (4) < 0.005 (4) < 0.005 (4) < 0.005 (4) [a]	HLA-6012-322; 070-90-0010R
				0 1 3 5	< 0.005 (3), < 0.002, < 0.005, < 0.002 (3), < 0.005 (4) < 0.005 (4)	included	< 0.005 (4) < 0.005 (4) < 0.005 (4) < 0.005 (4) [a]	
Netherlands, 1998	Korinda	16, 18, 20, 20	fruiting	0 3	0.007, 0.003 0.002 (0.002, < 0.002)	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	1119/98; KN Pijnacker

Country (year)	Cucumber variety	Application rate, g ai/ha	Growth stage BBCH	DAT, days	Residue Found (mg/kg)			Study; trial
					Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
Netherlands, 1998	Korinda	17, 18, 20, 20	fruiting	0 3	0.004, 0.004 <u>0.003</u> (0.004, 0.002)	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	1120/98; AX Delfgauw
Netherlands, 1998	Korinda	4× 22	fruiting	0 3	0.004, 0.003 <u>0.002</u> (0.003, 0.002)	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	1121/98; AX Delfgauw
Netherlands, 1998	Korinda	21 + 3× 22	fruiting	0 3	0.003, 0.002 <u>< 0.002</u> (2)	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	1122/98; BE Delfgauw
Netherlands 2013	Venice	4× 22	60–79	–0 0 3 7	< 0.002 0.006 <u>0.002</u> < 0.002	< 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002	S12-04361-01
Netherlands 2013	Euforia	2× 21 2× 22	60–79	–0 0 3 7	0.006 0.007 <u>0.007</u> 0.003	< 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002	S12-04361-02
Netherlands 2013	Carambole	2× 21 2x 22	60–79	–0 0 3 7	0.002 0.005 <u>0.005</u> 0.002	< 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002	S12-04361-03
Netherlands 2013	Hyjack	4× 21	60–79	–0 0 3 7	0.004 0.007 <u>0.004</u> < 0.002	< 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002	S12-04361-04
Spain 1999	Darina	21, 2x 22	87–89	0 3	0.007 (2) <u>< 0.002</u> (2)	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	1106/99
Spain 1999	Darina	2× 21, 22	83–89	0 3	0.004, 0.005 <u>< 0.002</u> (2)	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	1107/99
Spain 2000	Edona	3× 18, 20	87–89	0 3	0.004 <u>0.002</u> (2)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	1040/00
Spain 2000	Edona	2× 18 2x 19	85–89	0 3	0.012 <u>< 0.002</u> (2)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	1041/00
Spain 2001	Marumba	4× 22	85–87	0 3	0.002 <u>< 0.002</u> (2)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	1048/01; Carchuna
Spain 2002	Borja	20, 3× 22	75–715	0 4	0.004 <u>0.002</u> (0.003, < 0.002)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	02-1036; El Ejido
UK 1999	Brunex	5, 3× 6, 7, 9	–	0 4	0.005, 0.003 < 0.002 (2)	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	1035/99
UK 1999	Cumlaud	6, 7, 10, 10, 8, 8	–	0 3	0.0024, 0.0029 < 0.002 (2)	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	1036/99
UK 1999	–	4, 5, 8, 14, 16, 17	–	0 3	0.010 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	1037/99

Country (year)	Cucumber variety	Application rate, g ai/ha	Growth stage BBCH	DAT, days	Residue Found (mg/kg)			Study; trial
					Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
UK 1999	Cumlaud	7, 6, 8, 12, 10, 16	–	0 3	0.002, < 0.002 < 0.002 (2)	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	1038/99

[a] Includes the 8,9-z isomer of avermectin B_{1b}

Melons

Thirteen supervised residue trials were conducted on protected melons in Europe during 2000 to 2002 and in 2008. Melon samples were stored deep-frozen for a maximum of 23 months and residues in peel and pulp analysed by LC-MS/MS. Residues in the whole fruit were calculated from residues in peel and pulp. Results from the supervised trials on protected melons in Europe are summarized in Table 66.

Table 66 Results from protected supervised trials conducted with abamectin on melons in Europe

Country (Year)	Melon variety	Application rate, g ai/ha	Growth stage (BBCH)	DAT, days	Crop Part	Residue Found (mg/kg)			Study; trial
						Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
France 2000	Pancha	18, 2× 19, 20	55–89	0 3	fruit fruit	0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	0032401
France 2000	Lunastar	2× 18, 19	63–81	0 3	fruit fruit	0.004 < 0.002 (2)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	0032402
France 2002	Nastar	4× 18	71–74	0 0 0 3 3 3	peel pulp fruit peel pulp fruit	0.0058 < 0.002 0.003 0.002 (2) < 0.002 (2) < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 (2) < 0.002 (2) < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 (2) < 0.002 (2) < 0.002 (2)	02-1028; Montalzat
France 2002	Cyrano	4× 18	71–87	0 0 0 3 3 3	peel pulp fruit peel pulp fruit	0.010 < 0.002 0.006 0.004 (2) < 0.002 (2) 0.002 (0.003, 0.002)	< 0.002 < 0.002 < 0.002 < 0.002 (2) < 0.002 (2) < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 (2) < 0.002 (2) < 0.002 (2)	02-1029; Vazecar
France 2002	Escrito	4× 18	63–81	0 0 0 3 3 3	peel pulp fruit peel pulp fruit	0.004 < 0.002 0.002 0.002, < 0.002 < 0.002 (2) < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 (2) < 0.002 (2) < 0.002(2)	< 0.002 < 0.002 < 0.002 < 0.002 (2) < 0.002 (2) < 0.002(2)	02-1030; Loriol du Comtat
France 2008	Darius	4× 22	71–74	–0 –0 –0 0 0 0 1 1 1 3 3 3 7 7 7	*peel* *pulp* fruit *peel* *pulp* fruit *peel* *pulp* fruit *peel* *pulp* fruit *peel* *pulp* fruit	< 0.002 < 0.002 < 0.002 0.007 < 0.002 0.004 0.008 < 0.002 0.005 0.004 < 0.002 0.003 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	CEMS-3917; S08-00835-01

Country (Year)	Melon variety	Application rate, g ai/ha	Growth stage (BBCH)	DAT, days	Crop Part	Residue Found (mg/kg)			Study; trial
						Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
France 2008	Darius	22, 21	73, 74	–0	*peel*	< 0.002	< 0.002	< 0.002	CEMS-3917; S08-00835-01
				–0	*pulp*	< 0.002	< 0.002	< 0.002	
				–0	fruit	< 0.002	< 0.002	< 0.002	
				0	*peel*	0.005	< 0.002	< 0.002	
				0	*pulp*	< 0.002	< 0.002	< 0.002	
				0	fruit	0.003	< 0.002	< 0.002	
				1	*peel*	0.003	< 0.002	< 0.002	
				1	*pulp*	< 0.002	< 0.002	< 0.002	
				1	fruit	0.003	< 0.002	< 0.002	
				3	*peel*	< 0.002	< 0.002	< 0.002	
				3	*pulp*	< 0.002	< 0.002	< 0.002	
				3	fruit	< 0.002	< 0.002	< 0.002	
				7	*peel*	< 0.002	< 0.002	< 0.002	
				7	*pulp*	< 0.002	< 0.002	< 0.002	
				7	fruit	< 0.002	< 0.002	< 0.002	
France 2008	Anasta	21, 3× 22	65–85	–0	*peel*	0.007	< 0.002	< 0.002	CEMS-3916; S08-0836-1
				–0	*pulp*	< 0.002	< 0.002	< 0.002	
				–0	fruit	0.004	< 0.002	< 0.002	
				0	*peel*	0.008	< 0.002	< 0.002	
				0	*pulp*	< 0.002	< 0.002	< 0.002	
				0	fruit	0.005	< 0.002	< 0.002	
				1	*peel*	0.004	< 0.002	< 0.002	
				1	*pulp*	< 0.002	< 0.002	< 0.002	
				1	fruit	0.003	< 0.002	< 0.002	
				3	*peel*	0.003	< 0.002	< 0.002	
				3	*pulp*	< 0.002	< 0.002	< 0.002	
				3	fruit	0.003	< 0.002	< 0.002	
				7	*peel*	0.005	< 0.002	< 0.002	
				7	*pulp*	< 0.002	< 0.002	< 0.002	
				7	fruit	0.003	< 0.002	< 0.002	
Germany 2008	Charantaise	21, 3× 22	74–88	–0	*peel*	0.003	< 0.002	< 0.002	CEMS-3917; S08-00835-02
				–0	*pulp*	< 0.002	< 0.002	< 0.002	
				–0	fruit	0.002	< 0.002	< 0.002	
				0	*peel*	0.013	< 0.002	< 0.002	
				0	*pulp*	< 0.002	< 0.002	< 0.002	
				0	fruit	0.005	< 0.002	< 0.002	
				1	*peel*	< 0.002	< 0.002	< 0.002	
				1	*pulp*	< 0.002	< 0.002	< 0.002	
				1	fruit	< 0.002	< 0.002	< 0.002	
				3	*peel*	0.01	< 0.002	< 0.002	
				3	*pulp*	< 0.002	< 0.002	< 0.002	
				3	fruit	0.005	< 0.002	< 0.002	
				7	*peel*	0.006	< 0.002	< 0.002	
				7	*pulp*	< 0.002	< 0.002	< 0.002	
				7	fruit	0.003	< 0.002	< 0.002	
Italy 2008	Honey moon	21, 3× 22	69–75	–0	*peel*	< 0.002	< 0.002	< 0.002	CEMS-3916; S08-0836-2
				–0	*pulp*	< 0.002	< 0.002	< 0.002	
				–0	fruit	< 0.002	< 0.002	< 0.002	
				0	*peel*	0.009	< 0.002	< 0.002	
				0	*pulp*	< 0.002	< 0.002	< 0.002	
				0	fruit	0.006	< 0.002	< 0.002	
				1	*peel*	0.004	< 0.002	< 0.002	
				1	*pulp*	< 0.002	< 0.002	< 0.002	
				1	fruit	0.003	< 0.002	< 0.002	
				3	*peel*	0.002	< 0.002	< 0.002	
				3	*pulp*	< 0.002	< 0.002	< 0.002	
				3	fruit	0.002	< 0.002	< 0.002	
				7	*peel*	< 0.002	< 0.002	< 0.002	
				7	*pulp*	< 0.002	< 0.002	< 0.002	
				7	fruit	< 0.002	< 0.002	< 0.002	
Spain	Sanch	2× 17	61–89	0	fruit	< 0.002	< 0.002	< 0.002	02-1054;

Country (Year)	Melon variety	Application rate, g ai/ha	Growth stage (BBCH)	DAT, days	Crop Part	Residue Found (mg/kg)			Study; trial
						Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
2002	o	2× 18		3 3 3	peel pulp fruit	< 0.002 (2) < 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2) < 0.002 (2)	Mareny des Barraquetes
Spain 2002	Primat	3× 18	70–81	0 3 3 3	fruit peel pulp fruit	0.006 0.006, 0.004 < 0.002 (2) 0.002 (0.003, 0.002)	< 0.002 < 0.002 (2) < 0.002 (2) < 0.002(2)	< 0.002 < 0.002 (2) < 0.002 (2) < 0.002(2)	02-1055; Sanlucar de Barrameda
Spain	Galia-F	3× 18	70–81	0 3 3 3	fruit peel pulp fruit	< 0.002 < 0.002 (2) < 0.002 (2) < 0.002 (2)	< 0.002 < 0.002 (2) < 0.002 (2) < 0.002(2)	< 0.002 << 0.002 (2) < 0.002 (2) < 0.002(2)	1046/01; Chipiona

Peppers

Eighteen supervised trials were carried out on protected peppers between 1998 and 2013 in Europe. Samples of pepper fruits were stored deep-frozen for a maximum of 11 months and residues analysed either by LC/MS/MS or HPLC-FL. Four supervised trials were carried out on open field chilli peppers in the USA in 1994. Samples were stored deep-frozen for a maximum of 5.6 months and residues analysed by HPLC-LC. Summaries of the trial results are given in Table 67.

Table 67 Results from protected supervised trials conducted with abamectin on peppers in Europe (protected) and USA (field)

Country (year)	Pepper variety	Application rate, g ai/ha	Growth stage (BBCH)	DAT, days	Residue Found (mg/kg)			Study; trial
					Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
France 1998	Sweet, Spartacus	6× 22	67–76	-0 0 3 7 14	< 0.005 0.015 < 0.005 < 0.005 < 0.005	included	< 0.005 < 0.005 < 0.005 < 0.005 < 0.005 [a]	9830401; Ouvrouer les Champs
France 1998	Sweet, Evident	6× 22	73–78	3	< 0.005 (2)	included	< 0.005 (2) [a]	9830301; St Cyr en Val
France 1998	Sweet, Lipari	6× 22	701–705	-0 0 3 7 14	< 0.005 0.071 0.051 0.040 0.005	included	< 0.005 0.005 < 0.005 < 0.005 < 0.005 [a]	9830402; Monteux
France 1998	Sweet, Miami	6× 22	701–705	3	< 0.005 (2)	included	0.009, 0.010 [a]	9830302; Avignon
France 1999	Sweet, Spartacus	4× 22	65–73	0 3	0.011, 0.010 0.006 (0.006, 0.005)	included	< 0.002 (2) < 0.002 (2) [a]	9931501; Ouvrouer les Champs
France 1999	Sweet, Evident	4× 22	64–72	0 3	0.015, 0.020 0.005 (2)	included	< 0.002 (2) < 0.002 (2) [a]	9931502; Cyr en Val
France 2013	Vidi	5× 20	86–89	-0 0 3 7	0.013 0.020 0.025 0.016	< 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002	S12-04360-01
Italy	Green	4× 18	73–87	0	0.006	< 0.002	< 0.002	1042/01;

Country (year)	Pepper variety	Application rate, g ai/ha	Growth stage (BBCH)	DAT, days	Residue Found (mg/kg)			Study; trial
					Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
2001	Sienor			3	0.002	< 0.002	< 0.002	Bagnarola di Budrio
Netherlands 2013	Bell Waltz	5× 22	60–89	-0 0 3 7	0.018 0.025 0.022 0.027	< 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002	S12-04360-02
Netherlands 2013	Bell Maranello	5× 22	60–89	-0 0 3 7	0.011 0.019 0.015 0.010	< 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002	S12-04360-03
Netherlands 2013	Bell Maranello	5× 22	60–88	-0 0 3 7	0.013 0.035 0.019 0.016	< 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002	S12-04360-04
Spain 2001	Sweet, Gallego	20, 21, 22, 22	83–85	0 3	0.021 0.010 (0.012, 0.008)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	1047/01
Spain 1999	Sweet, Piquillo	2× 22 2× 23	87–89	0 3	0.051, 0.027 0.018 (0.019, 0.017)	0.004, 0.002 0.003 (2)	< 0.002 (2) < 0.002 (2)	1109/99
Spain 1999	Sweet, Itálico	21, 21, 22, 23	83–89	0 3	0.024, 0.025 0.008 (0.008, 0.009)	< 0.002 (2) 0.002, < 0.002	< 0.002 (2) < 0.002 (2)	1108/99; Sanlúcar de Barrameda
Spain 2002	Sweet, Herminio	4× 26	82	0 3	0.011 0.004 (0.002, 0.006)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	02-1053; El Mirador
Spain 2002	Sweet, Marnier	24, 25, 26, 28	61–89	0 3	0.024 0.002 (2)	< 0.002 < 0.002 (2)	0.002 < 0.002 (2)	02-1052; Mareny des Barraquets S
Switzerland 2000	Sweet, Goldflame	5× 22	63–73	0 3	0.035 0.012 (0.014, 0.010)	< 0.002 < 0.002 (2)	0.003 < 0.002 (2)	1006/00; 1006/00
Switzerland 2000	Sweet, Mazurka	5× 22	63–73	0 3	0.031 0.020 (0.020, 0.019)	< 0.002 < 0.002 (2)	0.002 < 0.002 (2)	1007/00; 1007/00
USA,TX 1994	Chilli, Jalapeño	6× 22	–	0 3 7	0.007, 0.005 < 0.005 (2) < 0.005 (2)	included	< 0.005 (2) < 0.005 (2) < 0.005 (2)	ADC 1452-1; 001-94-8000R
US, nm 1994	Chilli, Serrano	6× 22	–	0 3 7	0.012, 0.011 < 0.005 (2) < 0.005 (2)	included	< 0.005 (2) < 0.005 (2) < 0.05 (2)	ADC 1452-1; 001-94-8001R
USA AR 1994	Chilli, Serrano	6× 22	–	0 3 7	0.013, 0.012 < 0.005 (2) < 0.005 (2)	included	< 0.005 (2) < 0.005 (2) < 0.005 (2)	ADC 1452-1; 001-94-8002R
USA, CA 1994	Chilli, Jalapeño	6× 22	–	0 3 7	0.014, 0.015 < 0.005 (2) < 0.005 (2)	included	< 0.005 (2) < 0.005 (2) < 0.005 (2)	ADC 1452-1; 001-94-8003R

[a] Includes the 8,9-z isomer of avermectin B_{1b}

Tomatoes

Forty-two supervised trials were carried out on protected tomatoes in Europe in 1993, 1998, 2000, 2001, 2003, 2007 and 2008. Residues were analysed either by method 91.1 or by method REM 198.02 (equivalent to method MSD 8920 mod). Samples of tomato fruits were stored deep-frozen for a maximum of 16 months. Summaries of the trial results are given in Table 68.

Table 68 Results from supervised trials conducted with abamectin on tomato in Europe, either protected (P) or in the field (F)

Country (year)	Tomato variety (P or F)	Application rate, g ai/ha	Growth stage (BBCH)	DAT, days	Residue Found (mg/kg)			Study; trial
					Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
France 2000	Felicia (P)	4× 18	66–72	0 3	< 0.002 ≤ 0.002 (2)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	0031801
France 2000	Servanne (P)	4× 18	70–80	0 3	0.005 0.004 (0.003, 0.004)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	0031802
France 2000	Granitio (P)	4× 27	71–85	0 3 7	0.010 0.004 (0.004, 0.005) 0.003	< 0.002 < 0.002 (2) < 0.002	< 0.002 < 0.002 (2) < 0.002	0031901
France 2007	Sympathie (P)	2× 22	82–86	–0 0 1 3 7	0.005 0.009 0.010 0.011 0.005	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	CEMS-3518; AF/11536/SY/1
France 2007	Tornado (P)	2× 22	61–89	–0 0 1 3 7	< 0.002 0.003 0.002 ≤ 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	CEMS-3519; AF/11537/SY/1
Germany 2000	Vanessa (P)	5× 11	72–84	0 3	0.005 0.004	< 0.002 < 0.002	< 0.002 < 0.002	gr 71500; Rülzheim
Germany 2001	Pannovy (P)	17, 3x 18, 22	81–82	0 3	0.0095 0.004 (2)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	gto 35301; ross Gaglow
Germany 2001	Vanessa (P)	18, 2x19, 2x20	59–82	0 3	0.004 ≤ 0.002 (2)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	gto 55301; Eich
Germany 2007	Ochsenherz (P)	2× 20	73–83	–0 0 1 3 7	< 0.002 0.009 0.005 0.005 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	CEMS-3518; AF/11536/SY/2
Italy 2003	Naxos (P)	2× 22 2× 21	71–88	0 1 3 7 10	0.011 0.007 0.004 (0.004, 0.005) 0.002 0.002	< 0.002 < 0.002 < 0.002 (2) < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 (2) < 0.002 < 0.002	03-1025
Italy 2007	Caramba (P)	2× 22	85–87	–0 0 1 3 7	< 0.002 0.004 < 0.002 ≤ 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	CEMS-3519; AF/11537/SY/3
Netherlands 1993	Pronto (P)	4× 22	fruiting	0 3 7	0.009, 0.005 0.007 (0.009, < 0.005) 0.007, < 0.005	included	< 0.005 (2) < 0.005 (2) < 0.005 (2) [a]	1259B; 070-93-0001 R
Netherlands 1993	Pronto (P)	4× 22	fruiting	0 3 7	0.011, < 0.005 0.004 (0.067, < 0.005) 0.064, < 0.005	included	< 0.005 (2) < 0.005 (2) < 0.005 (2) [a]	1259B; 070-93-0002 R

Country (year)	Tomato variety (P or F)	Application rate, g ai/ha	Growth stage (BBCH)	DAT, days	Residue Found (mg/kg)			Study; trial
					Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
Netherlands 1993	Pronto (P)	4× 22	fruiting	0 3 7	0.014, 0.015 0.009 (0.011, 0.007) 0.010 (0.009, 0.012)	included	< 0.005 (2) < 0.005 (2) < 0.005 (2) [a]	1259B; 070-93-0003 R
Netherlands 1993	Trust (P)	4× 22	fruiting	0 3 7	0.006, < 0.005 0.006 (0.006, < 0.005) 0.007, < 0.005	included	< 0.005 (2) < 0.005 (2) < 0.005 (2) [a]	1259B; 070-93-0004 R
Netherlands 1993	(P)	4× 22	fruiting	0 3 7	0.019, 0.024 0.014 (0.010, 0.017) 0.007, 0.012	included	< 0.005 (2) < 0.005 (2) < 0.005 (2) [a]	1259B; 070-93-0005 R
Netherlands 1993	Pronto (P)	4× 22	fruiting	0 3 7	0.017, 0.018 0.012 (0.012, 0.011) 0.010, 0.008	included	< 0.005 (2) < 0.005 (2) < 0.005 (2) [a]	1259B; 070-93-0006 R
Netherlands 1998	Durintha (P)	3× 12, 14	71–83	0 3	0.003, 0.004 0.003 (2)	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	1124/98
Netherlands 1998	Durintha (P)	4× 12	71–83	0 3	0.002 (2) 0.003 (2)	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	1123/98; 1123/98
Netherlands 2000	Durinta (P)	5× 10	60–89	0 3	0.008 0.006, 0.007	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	1118/00
Netherlands 2001	Clarence (P)	9, 10, 11, 12, 11	harvest	0 3 7	0.005 0.003, 0.004 0.002	< 0.002 < 0.002 (2) < 0.002	< 0.002 < 0.002 (2) < 0.002	1113/01
Netherlands 2001	Prospero (P)	11, 14, 13, 15, 14	harvest	0 3 7	0.007 0.005, 0.006 0.0031	< 0.002 < 0.002 (2) < 0.002	< 0.002 < 0.002 (2) < 0.002	1112/01; Bleiswijk
Netherlands 2008	Korneett (P)	4× 22	60–89	–0 0 1 3 7 10	0.010 0.017 0.021 0.011 0.024 0.014	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	T000572-08-REG; S08-00801-01
Netherlands 2008	Brilliant (P)	4× 22	60–89	–0 0 1 3 7 10	0.010 0.011 0.010 0.014 0.018 0.027	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 0.002 0.003	T000572-08-REG; S08-00801-02
Netherlands 2008	Briljant (P)	4× 22	60–89	0 1 3 7 10	0.021 0.024 0.017 0.022 0.027	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	0.002 0.002 < 0.002 0.002 0.002	T000572-08-REG; S08-00801-03
Netherlands 2008	Tresco (P)	21, 4× 22	60–89	0 1 3 7 10	0.033 0.024 0.016 0.020 0.025	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	0.003 < 0.002 < 0.002 0.002 0.003	T000572-08-REG; S08-00801-04
Spain 2000	Daniela (P)	3× 18, 16	82–83	0 3 7	0.004 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 (2)	1008/00; Cañada de Gallego

Country (year)	Tomato variety (P or F)	Application rate, g ai/ha	Growth stage (BBCH)	DAT, days	Residue Found (mg/kg)			Study; trial
					Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
Spain 2000	Bond (P)	2× 19, 17, 18	71- 85	0 3 7	0.005 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 (2)	1009/00
Spain 2001	Romana (P)	23, 22, 22, 21	79–82	0 1 3 7	0.007 0.003 0.003 < 0.002, 0.002	< 0.002 < 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 0.002, < 0.002	1107/01; Canada Gallego
Spain 2001	Bond (P)	2× 22	75–74	0 1 3 7	0.004 0.004 0.003 0.002, 0.003	< 0.002 < 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 (2)	1108/01
		21, 20, 24, 23	73–75	0 1 3 7	0.008 0.003 0.004 0.004, 0.003	< 0.002 < 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 (2)	
Spain 2001	Bond (P)	22, 21	85–87	0 1 3 7	0.004 0.006 0.004 0.002, < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 (2)	1109/01
		2× 22 2× 21	83–87	0 1 3 7	0.010 0.005 0.003 < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 (2)	
Spain 2003	Jack (P)	2× 19 20, 22	71- 79	0 1 3 7 11	0.017 0.01 0.007 0.006 0.003	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	03-1019
France 2000	Promo (F)	4× 22	76–87	0 3 7	0.009 < 0.002 (2) < 0.002	< 0.002 < 0.002 (2) < 0.002	< 0.002 < 0.002 (2) < 0.002	0032001
Italy 2000	98063 (F)	3× 18	78–81	0 3 7	0.012 < 0.002 (2) < 0.002 (2)	< 0.002 < 0.002 (2) < 0.002 (2)	< 0.002 < 0.002 (2) < 0.002 (2)	1097/00; S.Giorgio Piacentino
Italy 2000	690 (F)	3× 18	81–89	0 3 7	0.006 < 0.002 (2) < 0.002 (2)	< 0.002 < 0.002 (2) < 0.002 (2)	< 0.002 < 0.002 (2) < 0.002(2)	1098/00; Lombardo
Italy 2001	Falco Rosso (F)	3× 22	81–87	0 3	0.0077 < 0.002 (2)	< 0.002 (2) < 0.002	< 0.002 (2) < 0.002	1043/01; Lagosanto
Italy 2001	Heinz 9478 (F)	3× 22	79–85	0 3	0.0071 < 0.002 (2)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	1044/01; Barbiano di Cotignola
Spain 1999	Bodar (F)	3× 22	71–73	0 3	0.006, 0.004 0.002 (0.002, < 0.002)	< 0.002 (2) 0.002 (2)	< 0.002 (2) 0.002 (2)	1110/99; Cullera
Spain 1999	Batlle (F)	3× 22	63–73	0 3	0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	1111/99; Picaña
Spain 2000	Batlle (F)	21, 2× 22	72–74	0 3	0.010 0.002 (2)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	1087/00; Picañia
Spain 2001	Royesca (F)	2× 21, 22	79–81	0 3	0.007 0.002 (2)	< 0.002 0.002 (2)	< 0.002 0.002 (2)	1086/01; Massalfassar

[a] Includes the 8,9-z isomer of avermectin B_{1b}

Eggplants

Two supervised trials were carried out on protected eggplants in 1998. Samples of eggplant fruits were stored deep-frozen for a maximum of 4 months and analysed by HPLC-FL. Summaries of the trial results are given in Table 69.

Table 69 Results from protected supervised trials conducted with abamectin on eggplant in France

Location	Eggplant variety	Application rate (g ai/ha)	Growth stage BBCH	DAT, days	Residues, mg/kg		Trial
					Abamectin B_{1a} + 8,9-Z-isomer	Abamectin B_{1b} + 8,9-Z-isomer	
Ouvrouer les Champs	Madona	6× 22	61–73	3	< 0.005 (2)	< 0.005 (2)	9830201
Calvisson	Telar	6× 22	501–504	–0 0 3 7 14	< 0.005 0.015 < 0.005 < 0.005 < 0.005	< 0.005 < 0.005 < 0.005 < 0.005 < 0.005	9830101

Lettuce

Thirty four supervised trials on protected lettuce and twelve trials on open-field lettuce were carried out in 1999 to 2008. Samples of lettuce were stored deep-frozen for a maximum of 16 months, and samples analysed by HPLC-FL or LC-MS/MS. Summaries of the trial results are given in Table 70.

Table 70 Results from supervised trials conducted with abamectin on lettuce in Europe, either protected (P) or in the field (F)

Country year	Lettuce variety (P or F)	Application		DAT (days)	Residues, mg/kg			Study, trial
		Rate, g ai/ha)	Growth Stage		Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
France 1999	Head lettuce, Angie (P)	4× (8–9)	42–48	0 3 7 14 21	0.36 0.25 0.20 0.097 0.059	included	0.014 0.009 0.008 0.004 0.002 [a]	0030301 Sandillon
France 1999	Head lettuce, Sensai (P)	4× (8–9)	19–45	0 3 7 14 21	0.340 0.100 0.050 0.020 0.006	included	0.013 0.004 0.002 < 0.002 > 0.002 [a]	0030302 St. Genouph
France 2000	Head lettuce, Kristo (P)	3, 3× 7	19–41	0 3 7 14	0.114 0.043 0.021 0.11 (0.010, 0.012)	< 0.002 0.003 < 0.002 < 0.002 (2)	0.007 0.003 < 0.002 < 0.002 (2)	1114/00
France 2000	Head lettuce, Angié (P)	2× 3 2× 6	16–47	0 3 7 14	0.151 0.048 0.026 0.005, 0.006	< 0.002 0.005 0.004 < 0.002 (2)	0.009 0.003 < 0.002, < 0.002 (2)	1115/00
France 2000	Head lettuce, Angié (P)	2, 3, 4, 7	15–41	0 3 7 13	0.115 0.032 0.008 0.004, 0.003	< 0.002 < 0.002 < 0.002 < 0.002 (2)	0.008 0.002 < 0.002 < 0.002 (2)	1116/00
France 2000	Head lettuce, Sensaï (P)	2, 3, 3, 7	15–41	0 3 7 13	0.143 0.064 0.016 0.009, 0.008	< 0.002 0.002 < 0.002 < 0.002 (2)	0.009 0.004 < 0.002 < 0.002 (2)	1117/00
France 2005	Cambria (P)	4× 9	13–19	–0 0 3 7	0.015 0.34 0.057 0.015	< 0.002 0.003 0.006 0.002	< 0.002 0.024 0.003 < 0.002	05-0501; AF/8590/SY/4

Country year	Lettuce variety (P or F)	Application		DAT (days)	Residues, mg/kg			Study, trial
		Rate, g ai/ha)	Growth Stage		Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
				14 21	0.003 < 0.002	< 0.002 < 0.002	< 0.002 < 0.002	
France 2005	Lettuce (P)	4× 9	16–46	–0 0 14	0.012 0.204 0.004	< 0.002 < 0.002 < 0.002	< 0.002 0.016 < 0.002	05-0501; AF/8590/SY/5
France 2005	Grinil (P)	4× 9	14–46	–0 0 14	0.011 0.261 0.003	< 0.002 < 0.002 < 0.002	< 0.002 0.015 < 0.002	05-0501; AF/8590/SY/6
France 2008	Head, Palomis (P)	4× 9	17–45	–0 0 3 7 14 21	0.028 0.122 0.087 0.038 0.019 0.008	0.002 < 0.002 0.005 0.002 < 0.002 < 0.002	0.003 0.015 0.009 0.003 < 0.002 < 0.002	T000573-08-REG; S08-00802-01
United Kingdom 1999	Head lettuce (P)	4× (3–4)	15–42	0 14	0.348, 0.315 < 0.002 (2)	0.005 (2) < 0.002 (2)	0.019, 0.018 < 0.002 (2)	1039/99
United Kingdom 1999	Head lettuce (P)	4× (3–4)	16–42	0 14	0.225, 0.247 < 0.002 (2)	< 0.002 (2) < 0.002 (2)	0.013 (2) < 0.002 (2)	1040/99
United Kingdom 1999	Head lettuce, Vegas (P)	4× (3–4)	16–41	0 3 7 10 14	0.162 0.060 0.026 0.016 0.010, 0.012	< 0.002 0.007 0.004 0.002 < 0.002 (2)	0.009 0.003 < 0.002 < 0.002 < 0.002 (2)	1041/99
United Kingdom 1999	Head lettuce, Frandria (P)	4× (3–4)	15–42	0 4 8 11 14	0.086 0.005 0.004 0.002 0.002 (2)	0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2)	0.005 < 0.002 < 0.002 < 0.002 < 0.002 (2)	1042/99
United Kingdom 2005	Lettuce, Josephine (P)	4× 9	15–39	–0 0 3 7 14 21	0.004 0.365 0.047 0.022 0.004 < 0.002	< 0.002 < 0.002 0.003 < 0.002 < 0.002 < 0.002	< 0.002 0.015 0.003 < 0.002 < 0.002 < 0.002	05-0501; AF/8590/SY/1
United Kingdom 2005	Alexander (P)	4× 9	33–47	–0 0 14	0.037 0.132 0.012	0.003 0.003 < 0.002	0.003 0.010 < 0.002	05-0501; AF/8590/SY/2
United Kingdom 2005	Head, Brian (P)	4× 9	16–45	–0 0 14	0.019 0.301 0.007	0.003 < 0.002 < 0.002	< 0.002 0.024 < 0.002	05–0501; AF/8590/SY/3
United Kingdom 2008	Head, Whiske (P)	4× 9	33–45	–0 0 3 7 14 21	0.044 0.243 0.100 0.050 0.035 0.020	< 0.002 < 0.002 0.003 0.003 0.003 < 0.002	0.005 0.028 0.013 0.006 0.004 0.003	T000573-08-REG;S08-00802-02
United Kingdom 2008	Head, Brian (P)	4× 9	32–45	0 3 7 14 21	0.344 0.122 0.061 0.045 0.043	0.005 0.009 < 0.002 0.004 0.004	0.036 0.015 0.007 0.006 0.005	T000573-08-REG FSGD-045; S08-00802-03
United Kingdom 2008	Head, Whiske (P)	4× 9	37–45	0 3 7 14 21	0.255 0.104 0.071 0.047 0.025	0.002 0.003 0.002 0.003 < 0.002	0.027 0.012 0.008 0.005 0.003	T000573-08-REG FSGD-045; S08-00802-04
France 2007	Head, Iceberg (F)	2× 18	43–48	–0 0 1 3	< 0.002 0.193 0.016 0.003	< 0.002 < 0.002 < 0.002 < 0.002	< 0.002 0.013 < 0.002 < 0.002	CEMS-3517; AF/11534/SY/2

Country year	Lettuce variety (P or F)	Application		DAT (days)	Residues, mg/kg			Study, trial
		Rate, g ai/ha)	Growth Stage		Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
				7 14	0.003 < 0.002	< 0.002 < 0.002	< 0.002 < 0.002	
France 2000	Cos lettuce Green Tower (F)	3× 18	19–47	0 3 7	0.17 0.003 (2) < 0.002	< 0.002 < 0.002 (2) < 0.002	0.019 < 0.002 (2) < 0.002	0032102
France 2000	Cos lettuce Alisia (F)	3× 18	19–49	0 3 7	0.24 0.011, 0.010 0.003	< 0.002 < 0.002 (2) < 0.002	0.014 < 0.002 (2) < 0.002	0032101
France 2003	Lamb’s, Gala (F)	9	Cotyledon	14	< 0.005	–	< 0.005	RLMA21903; RE03019
France 2003	Lamb’s, Gala (F)	9	Cotyledon	14	< 0.005	–	< 0.005	RLMA21903; RE03020
France 2007	Head, Italina (F)	2× 18	19–41	–0 0 1 3 7 14	0.005 0.318 0.101 0.049 0.003 < 0.002	< 0.002 0.006 0.008 0.003 < 0.002 < 0.002	< 0.002 0.038 0.010 0.005 < 0.002 < 0.002	CEMS-3516; AF/11535/SY/1
Italy 2000	Cos lettuce Sofia (F)	3× 18	43–48	0 3 7	0.125 0.010, 0.012 0.008 (0.011, 0.006)	0.002 < 0.002 (2) < 0.002 (2)	0.008 < 0.002 (2) < 0.002 (2)	1095/00
Italy 2000	Cos lettuce Canasta Semi-open (F)	3× 18	41–49	0 3 7	0.034 0.015, 0.010 0.006 (0.005, 0.007)	0.005 0.002, < 0.002 < 0.002 (2)	0.023 < 0.002 (2) < 0.002 (2)	1096/00 Mediglia
Italy 2007	Head Gentilina Open (F)	18, 19	43–45	–0 0 1 3 7 14	0.041 0.556 0.374 0.018 < 0.002 < 0.002	< 0.002 0.011 0.008 < 0.002 < 0.002 < 0.002	0.003 0.051 0.048 < 0.002 < 0.002 < 0.002	CEMS-3516; AF/11535/SY/2
Spain 1992	Leaf lettuce Summer Blond (F)	4×22	–	0 7 14	0.198, 0.163, 0.171, 0.188 0.007 (0.007, 0.008, 0.009, 0.004) < 0.002 (4)	inlcuded	0.021, 0.018, 0.018, 0.021 < 0.002 (4) < 0.002 (4) [a]	1274-4 ADC; 065-92- 0003R
		4× 43	–	0 7 14	0.361, 0.437 0.298, 0.465 0.025 (2), 0.028, 0.024 0.004, 0.005 0.002, 0.003	inlcuded	0.041, 0.045, 0.030, 0.053 0.002 (2), < 0.002 (2) < 0.002 (4) [a]	
Spain 1992	Leaf lettuce Inverna (F)	4×22	–	0 7 14	0.210, 0.166, 0.182, 0.242 0.004 (0.005, 0.004, 0.003, 0.004) 0.002, < 0.002 (3)	inlcuded	0.025, 0.019, 0.021, 0.028 < 0.002 (4) < 0.002 (4) [a]	1274-5 ADC; 065-92- 0004R
		4× 43	–	0 7 14	0.396, 0.216, 0.544, 0.417 0.006, 0.005 (3) 0.003, 0.002 (2), < 0.002,	inlcuded	0.047, 0.024, 0.061, 0.048 < 0.002 (4) < 0.002 (4) [a]	
United Kingdom 2007	Head Brenson (F)	2× 18	45–47	–0 0 1 3	0.002 0.455 0.333 0.010	< 0.002 0.027 0.025 < 0.002	< 0.002 0.035 0.026 < 0.002	CEMS-3517; AF/11534/SY/1

Country year	Lettuce variety (P or F)	Application		DAT (days)	Residues, mg/kg			Study, trial
		Rate, g ai/ha)	Growth Stage		Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
				7 14	0.005 < 0.002	< 0.002 < 0.002	< 0.002 < 0.002	

[a] Includes the 8,9-z isomer of avermectin B_{1b}

Spinach

Eleven supervised trials were conducted in the USA on open field spinach in 1995, 1996, and 2007/08. Samples of spinach were stored deep-frozen for a maximum of 6 months and analysed by HPLC-FL. Summaries of the trial results on spinach are given in Table 71.

Table 71 Results from supervised trials conducted with abamectin on spinach in USA

Location year	Spinach variety	Application rate, g ai/ha	Growth stage	DAT, days	Residue Found (mg/kg)		Recovery Data
					Avermectin B_{1a} + 8,9-Z-isomer	Avermectin B_{1b} + 8,9-Z-isomer	
California 1995	Bossanova	6× 21	immature–mature	0 7 14	0.71, 0.58, 0.58, 0.40 0.028 (0.031, 0.023, 0.034, 0.024) 0.008 (2)	0.060, 0.040 0.003 (2) < 0.002 (2)	ABR-98078; 001-95-1018R
Texas 1995	Bolero	6× 21	7 in. rosette –12 in. tall	0 7 14	0.71, 0.57 0.085 (0.091, 0.079) 0.026, 0.022	0.072, 0.054 0.008, 0.007 0.002, < 0.002	ABR-98078; 001-95-8006R
Colorado 1996	Melody Firs	6× 21	1 in. tall –mature	0 7 14	0.56, 0.61 0.024 (0.021, 0.026) 0.017, 0.015	0.040, 0.041 < 0.002 (2) < 0.002 (2)	ABR-98078; 001-96-1002R
South Carolina 1996	Bloomsdale Long	6× 21	vegetative	0 7 14	0.86, 0.68 0.042 (0.046, 0.039) 0.017 (2)	0.086, 0.069 0.006, 0.004 0.003, 0.002	ABR-98078; 001-96-2000R
New Jersey 1996	Winter Bloomsdale	5× 21	1–3 in.–4–8 in. tall	0 7 14	0.28, 0.26 0.020 (0.022, 0.018) 0.011, 0.014	0.017, 0.016 < 0.002 (2) < 0.002 (2)	ABR-98078; 001-96-2001R
California 1996	Ty-ee	6× 21	first leaf-mature	0 7 14	0.81, 0.80 0.044 (0.043, 0.045) 0.024, 0.021	0.046, 0.048 0.003, 0.003 < 0.002 (2)	ABR-98078; 001-96-5014R
Virginia (2008)	Tyee F	3× 21	–	7	0.019, 0.012	< 0.002 (2)	T005593-07; E07VA078408
Oklahoma 2008	Spargo F	3× 22	BBCH 75–49	7	< 0.002 (2)	< 0.002 (2)	T005593-07; W01TX078413
Colorado 2008	Bloomsdale	3× 22	vegetative	7	< 0.002 (2)	< 0.002 (2)	T005593-07; W12CO078414
California 2007	Hybrid 7	3× 22	BBCH 49	7	0.048 (0.056, 0.040)	0.004, 0.003	T005593-07; W29CA078427
California 2008	Bloomsdale	3× 21	14–30 leaves	7	0.021 (0.022, 0.019)	< 0.002 (2)	T005593-07; W28CA078428

Beans, green with pods

Sixteen trials on protected fresh beans were carried out in Europe between 2000 and 2009. Samples of green bean were stored deep-frozen for a maximum of 22 months and analysed by LC-MS/MS. Summaries of the trial results are given in Table 72.

Table 72 Results from green house supervised trials conducted with abamectin on beans, green with pods in Europe

Country year	Bean variety	Application rate, g ai/ha	Growth stage, BBCH	DAT, days	Residue Found (mg/kg)			Study; trial
					Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
France 2008	Booster	3× 23	65–83	–0 0 1 3 7	0.018 0.042 0.028 0.029 0.026	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	CEMS 3913; S08-00832-01
	Booster	2× 22	65–83	–0 0 1 3 7	0.023 0.047 0.043 0.023 0.020	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	
Italy 2008	Oriente	23, 20, 22	76–83	–0 0 1 3 7	< 0.002 0.038 0.011 0.016 0.008	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 0.002 < 0.002 < 0.002 < 0.002	CEMS 3913; S08-00832-02
	Oriente	22, 21	77–83	–0 0 1 3 7	< 0.002 0.036 0.026 0.012 0.010	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 0.003 < 0.002 < 0.002 < 0.002	
Spain 2000	Perona	3× 18	65–81	0 3 7	0.010 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 (2)	1010/00; Emperador
Spain 2000	Perona	20, 17, 18	66–83	0 3 7	0.022 0.003 < 0.002 (2)	< 0.002 < 0.002 < 0.002 (2)	0.002 < 0.002 < 0.002 (2)	1011/00 Serratelia
Spain 2000	French	17, 18, 19	63–82	0 3 7	0.040 0.017 0.007 (2)	< 0.002 < 0.002 < 0.002 (2)	0.003 < 0.002 < 0.002 (2)	1012/00 Alberic
Spain 2000	Punxeta	3× 18	65–83	0 3 7	0.026 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 (2)	0.002 < 0.002 < 0.002 (2)	1013/00 Xereza
Spain 2001	Doma	3× 21	75–77	0 3	0.017 0.007 (2)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	1081/01 Carchuna
Spain 2002	Maite R2	3× 22	78	0 3	0.007 < 0.002 (2)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	1082/01 Motril
Spain 2001/02	Dona	13, 15, 18	71–74	0 3	0.008 < 0.002 (2)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	1083/01 El-Ejido
Spain 2002	Oriente	17, 17, 21	63–67	0 3	0.022 0.004 (0.006, 0.003)	< 0.002 < 0.002 (2)	< 0.002 < 0.002 (2)	1084/01 El-Ejido
Spain 2008	Emerite	22, 22, 21	71–85	–0 0 1 3 7	0.015 0.067 0.052 0.049 0.028	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 0.004 0.002 0.002 < 0.002	CEMS-3913 S08-00832-03
	Emerite	2× 22	72–85	–0 0 1 3 7	0.009 0.075 0.046 0.048 0.037	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 0.003 0.002 0.003 0.002	
Spain 2008	Killy	20, 22, 22	76–77	–0 0 1 3 7	0.009 0.043 0.020 0.014 0.015	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	< 0.002 0.004 0.003 0.003 0.003	CEMS-3913 S08-00832-04
	Killy	22, 21	76 77	–0 0 1	0.009 0.036 0.019	< 0.002 < 0.002 < 0.002	< 0.002 0.004 0.003	

Country year	Bean variety	Application rate, g ai/ha	Growth stage, BBCH	DAT, days	Residue Found (mg/kg)			Study; trial
					Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
				3 7	0.014 0.009	< 0.002 < 0.002	0.003 0.003	

Beans (dry)

Twelve supervised residue trials were conducted on beans in the USA during 1999. In all trials, duplicate samples of dry beans were analysed by HPLC-FL. Dry bean samples were stored deep-frozen for a maximum of 14 months. Summaries of the trial results are given in Table 73.

Table 73 Results from supervised trials conducted with abamectin on dry beans in the USA in 1999 (Study 05001)

Region	Bean variety	Application rate, g ai/ha	Growth Stage	DAT, days	Residues, mg/kg		
					Avermectin B_{1a}+ 8,9-Z-isomer	Avermectin B_{1b}	Trial
New Jersey	ETNA	3× 20	vegetative pods filled	7	< 0.002 (2)	< 0.002 (2)	NJ26
Wisconsin Arlington	Great Northern Dry Bean	21, 20, 20	fruiting mature	5	< 0.002 (2)	< 0.002 (2)	WI13
Wisconsin Hancock	Great Northern Dry Bean	22, 24, 22	flowering, fruiting	6	< 0.002 (2)	< 0.002 (2)	WI14
Wisconsin Hancock	Great Northern Dry Bean	24, 22, 21	yellow-pods drying to mature	5	< 0.002 (2)	< 0.002 (2)	WI15
N. Dakota Minot	Maverick	3× 21	mature	7	< 0.002 (2)	< 0.002 (2)	ND05
N. Dakota Minot	Maverick	3× 21	mature	7	< 0.002 (2)	< 0.002 (2)	ND06
Ohio Freemont	Avanti–navy	3× 21	bloom and fruit	7	< 0.002 (2)	< 0.002 (2)	OH*10
Ohio Freemont	Avanti–navy	3× 21	Fruit–senescing	7	< 0.002 (2)	< 0.002 (2)	OH*11
Washington Moxee	Othello	3× 22	fruiting	7	< 0.002 (2)	< 0.002 (2)	WA*14
Washington Moxee	Othello	3× 21	fruiting	7	< 0.002 (2)	< 0.002 (2)	WA*15
California	CB-46	3× 21	maturing	6	0.003 (0.004, < 0.002)	< 0.002 (2)	CA57
Idahoo	Bill Z. Pinto	3× 21	maturing –drying	7	< 0.002 (2)	< 0.002 (2)	ID04

Celeriac

Two supervised residue trials were conducted on celeriac in the USA during 1998. Duplicate samples of celeriac (roots and tops) were analysed by HPLC-FL. Celeriac samples were stored deep-frozen for a maximum of 9.4 months for roots and 10.5 months for tops. Summaries of the trial results are given in Table 74.

Table 74 Results from supervised trials conducted with abamectin on celeriac in the USA in 1998 (Study: 06593)

Location [a]	Celeriac variety	Application rate, g ai/ha	Growth stage	DAT (days)	Crop Part	Residues, mg/kg		Trial
						Avermectin B_{1a} + 8,9-Z-isomer	Avermectin B_{1b} + 8,9-Z-isomer	
Paerlier CA	Brilliant	3× 22	maturing to mature	7	roots tops	< 0.002 (2) 0.005, 0.004	< 0.002 (2) < 0.002 (2)	98-CA06
Paerlier CA	Brilliant	3× 22	maturing root	7	roots tops	< 0.002 (2) 0.015, 0.014	< 0.002 (2) < 0.002 (2)	98-CA07

[a] Same location, but conducted in periods about 2 months apart

Potatoes

Eighteen supervised residue trials were conducted on potatoes in the USA in the growing seasons 1992–1994 and 1998. Potato samples were stored deep-frozen for a maximum of 15 months and analysed by HPLC-FL. Summaries of the trial results are given in Table 75.

Table 75 Results from supervised trials conducted with abamectin on potatoes in the USA

Location year	Potato variety	Application rate, g ai/ha	Growth stage	DAT, days	Residues, mg/kg		Report; Trial
					Avermectin B_{1a}+ 8,9-Z-isomer	Avermectin B_{1b} + 8,9-Z-isomer	
New York 1992	Katahdin	6× 112	foliage to mature	0 3 7	< 0.005 (2) < 0.005 (2) < 0.005 (2)	< 0.005 (2) < 0.005 (2) < 0.005 (2)	618-0936-3671; 001-92-5017R
		6× 112	foliage to mature	0 3 7	< 0.005 (2) < 0.005 (2) < 0.005 (2)	< 0.005 (2) < 0.005 (2) < 0.005 (2)	
Pensylvania 1992	Katahdin	6× 112		0 3 7	< 0.005 (2) < 0.005 (2) < 0.005 (2)	< 0.005 (2) < 0.005 (2) < 0.005 (2)	618-0936-3671; 001-92-5018R
		6× 112		0 3 7	< 0.005 (2) < 0.005 (2) < 0.005 (2)	< 0.005 (2) < 0.005 (2) < 0.005 (2)	
Oregon 1992	Russet Burbank	6× 112		0 3 7	< 0.005 (2) < 0.005 (2) < 0.005 (2)	< 0.005 (2) < 0.005 (2) < 0.005 (2)	618-0936-3671; 001-92-5019R
		6× 112		0 3 7	< 0.005 (2) < 0.005 (2) < 0.005 (2)	< 0.005 (2) < 0.005 (2) < 0.005 (2)	
Zelwood, FL 1993	Red La Soda	6× 21		0 14	< 0.005 (2) ≤ 0.005 (2)	< 0.005 (2) < 0.005 (2)	618-936-93671; 001-93-0002R
La Belle, FL 1993	Atlantic	6× 112		0 3 7	< 0.005 (2) < 0.005 (2) < 0.005 (2)	< 0.005 (2) < 0.005 (2) < 0.005 (2)	618-936-93671; 001-92-0038R
		6× 112		0 3 7	< 0.005 (2) < 0.005 (2) < 0.005 (2)	< 0.005 (2) < 0.005 (2) < 0.005 (2)	
Amercian Falls, ID 1993	Russet Burbank	6× 18-21	≤ 5 oz to maturity	0 14	< 0.005 (2) ≤ 0.005 (2)	< 0.005 (2) < 0.005 (2)	618-936-93671; 001-93-1004R
Jerome, ID 1993	Russet Burbank	6× 21	75% to 90% mature	0 14	< 0.005 (2) ≤ 0.005 (2)	< 0.005 (2) < 0.005 (2)	618-936-93671; 001-93-1005R
Mason, MI 1993	Snowden	6× 19-22	senescence to maturity	0 14	< 0.005 (2) ≤ 0.005 (2)	< 0.005 (2) < 0.005 (2)	618-936-93671; 001-93-1007R
Washington 1993	Russet Burbank	6× 21	3–4 in. to 24–26 in. high	0 14	< 0.005 (2) ≤ 0.005 (2)	< 0.005 (2) < 0.005 (2)	618-936-93671; 001-93-5004R
Hugson, CA 1993	Red Lasoda	6× 21	9–15 in. to 10–15 in. high	0 14	< 0.005 (2) ≤ 0.005 (2)	< 0.005 (2) < 0.005 (2)	618-936-93671; 001-93-5005R
Bakersfield, CA 1993	Russet Norkotah	6× 21	1.5–2 in. tubers vines dry	0 14	< 0.005 (2) ≤ 0.005 (2)	< 0.005 (2) < 0.005 (2)	618-936-93671; 001-93-5006R
Maryland 1993	White Superior	6× 21	starting to bloom mature	0 14	< 0.005 (2) ≤ 0.005 (2)	<< 0.005 (2) < 0.005 (2)	618-936-93671; 001-93-7000R
New York 1993	White Katahdin	6× 21	18 in. high senescence starting	0 14	< 0.005 (2) ≤ 0.005 (2)	< 0.005 (2) < 0.005 (2)	618-936-93671; 001-93-7001R
Maine 1993	FL1625	6× 21	20 in.–bloom to post bloom	0 14	< 0.005 (2) ≤ 0.005 (2)	< 0.005 (2) < 0.005 (2)	618-936-93671; 001-93-7002R

Location year	Potato variety	Application rate, g ai/ha	Growth stage	DAT, days	Residues, mg/kg		Report; Trial
					Avermectin B_{1a}+ 8,9-Z-isomer	Avermectin B_{1b} + 8,9-Z-isomer	
North Dakota 1994	Norchip	6× 21	18–24 in. high	0 14	< 0.005 (2) < 0.005 (2)	< 0.005 (2) < 0.005 (2)	618-936-93671; 001-94-1017R
Colorado 1994	Russet Nugget	6× 112	61–76 cm	0 14	< 0.005 (4) < 0.005 (4)	< 0.005 (4) < 0.005 (4)	618-936-93671; 001-94-1022R
Washingto n 1998	Russet Burban k	3× 21	–	14	< 0.005 (2)	< 0.005 (2)	T000141-98; 0W-IR-601-98
N w York 1998	Katahdi n	3× 21	–	15	< 0.005 (3)	< 0.005 (2)	T000141-98;05-IR-006-98

Radish

Three supervised decline trials were carried out on protected radishes in 1996 and 1999 in the Netherlands. Residues in radish (whole plant, roots, and leaves with tops) were analysed by HPLC-FL or LC-MS/MS. Samples of radish were stored deep-frozen for a maximum of 8 months. Summaries of the trial results are given in Table 76.

Table 76 Results from protected supervised trials conducted with abamectin on radishes in the Netherlands

Year	Radish variety	Application rate, g ai/ha	DAT, days	Crop Part	Residues, mg/kg			Report; trial
					Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
1999	Donar	2× 10	0 3 7 7 10 10 12 12	w. plant w. plant leaf roots leaf roots leaf roots	0.324 0.106 0.074 < 0.002 0.061 < 0.002 0.08, 0.07 < 0.002 (2)	0.016 0.01 0.007 < 0.002 0.006 < 0.002 0.007, 0.006 < 0.002 (2)	0.019 0.007 0.004 < 0.002 0.004 < 0.002 0.004 (2) < 0.002 (2)	1015/99; 1- s-Gravenzande
1996	Nevada	15	0 14 14 21 21 28 28	w. plant leaf root leaf root leaf root	0.803 0.014 < 0.002 0.013, 0.012 < 0.002 0.009 < 0.002	included	0.061 < 0.002 < 0.002 < 0.002 (2) < 0.002 < 0.002 < 0.002	MEK34/9711 69; 070-96-0003R
		15	0 14 14 21 21 28 28	w. plant leaf root leaf root leaf root	0.835, 0.856 0.010 < 0.002 (2) 0.012 < 0.002 0.009 < 0.002	included	0.066, 0.063 < 0.002 < 0.001 (2) < 0.002 < 0.002 < 0.002 < 0.002	
1996	Nevada	14	0 14 14 21 21 28 28	w. plant leaf root leaf root leaf root	0.794 0.014 < 0.002 0.009 < 0.002 0.007, 0.008 < 0.002	included	0.054 < 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2) < 0.001	MEK34/9711 69; 070-96-0004R
		14	0 14 14	w. plant leaf root	0.789 0.006 < 0.002	included	0.059 < 0.002 < 0.002	

Year	Radish variety	Application rate, g ai/ha	DAT, days	Crop Part	Residues, mg/kg			Report; trial
					Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
			21 21 28 28	leaf root leaf root	0.007 < 0.002 0.007 < 0.002		< 0.002 < 0.002 < 0.002 < 0.002	

Celery

Seven trials were carried out on <u>celery</u> in southern European in the period 1999–2002. Samples of celery whole plant and leaf stalk were stored deep-frozen for a maximum of 8 months and residues in celery analysed by LC-MS/MS. Six trials on celery were conducted in the USA in the period 1999 and 2008. Samples were stored deep-frozen for a maximum of 16 months and analysed by HPLC-FL. Summaries of the trial results are given in Table 77.

Table 77 Results from supervised trials conducted with abamectin on celery

Country year	Celery variety	Application rate, g ai/ha	Growth stage BBCH	DAT, days	Residues, mg/kg			Report; trial
					Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
Italy 2002	Elena-Francese	3× 22	41–49	0 10	0.225 0.002	0.004 < 0.002	0.013 < 0.002	02-1150; Polig-nano a Mare
Spain 1999	Utha	3× 22	33–37	0 3 7 10	0.014 0.004 0.003 (2) 0.002	< 0.002 < 0.002 < 0.002 (2) < 0.002	< 0.002 < 0.002 < 0.002 (2) < 0.002	1001/99 El Siscar
Spain 1999	Utha	3× 22	33–37	0 3 7 10	0.020 0.017 0.003, 0.004 0.006	< 0.002 < 0.002 < 0.002 (2) < 0.002	< 0.002 < 0.002 < 0.002 (2) < 0.002	1002/99 El Siscar
Spain 2000	Slow Bolting	3× 22–23	42–45	0 3 7 10	0.013 0.012 < 0.002, 0.002 0.004	< 0.002 < 0.002 < 0.002 (2) < 0.002	< 0.002 < 0.002 < 0.002 (2) < 0.002	1002/00 El Siscar
Spain 2000	Utha 52-70R	3× 22	43–45	0 3 7 10	0.014 0.011 0.004, 0.003 < 0.002	< 0.002 < 0.002 < 0.002 (2) < 0.002	< 0.002 < 0.002 < 0.002 (2) < 0.002	1003/00
Spain 2000	Utha	3× 20–22	41–45	0 3 7 10	0.026, 0.021 0.005 (2) 0.015, 0.018, 0.003, 0.004 0.004, 0.003	< 0.002 (2) < 0.002 (2) < 0.002 (4) < 0.002 (2)	0.002, < 0.002 < 0.002 (2) < 0.002 (4) < 0.002 (2)	1004/00
Spain 2000	Elne	3× 22	19–49	0 7 10	0.075 0.009, 0.0180 0.010, 0.004	0.006 < 0.002 (2) < 0.002 (2)	0.0180 < 0.002 (2) < 0.002 (2)	1085/01 Sant Boi
USA, FL 2008	Golden Pascal	3× 21	vegetative	7	<u>0.005</u> (0.006, 0.004)	included	< 0.002 (2)	T005593-07 E16FL078411
USA, MI 2008	Green Bay	3× 21	BBCH 45–49	7	<u>0.005</u> (0.003, 0.007)	included	< 0.002 (2)	T005593-07 C01MI078412
USA, King	G-15	3× 22	BBCH	7	<u>0.003</u> (2)	included	< 0.002 (2)	T005593-07

Country year	Celery variety	Application rate, g ai/ha	Growth stage BBCH	DAT, days	Residues, mg/kg			Report; trial
					Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
City, CA2008			47–75					W32CA078415
USA, Madera, CA 2008 [a]	Salyer Sonora	3× 22	BBCH 45–49	7	0.006 (0.009, 0.004)	included	< 0.002 (2)	T005593-07 W29CA078416
USA, Madera, CA 2008 [a]	Salyer Sonora	3× 22	BBCH 47–49	0 3 7 10	0.31 0.024 0.016 (0.016, 0.015) 0.013	included	0.006 < 0.002 < 0.002 (2) < 0.002	T005593-07 W29CA078417
USA, St Maria, CA 2008	Conquistador	3× 21	BBCH 45–48	7	0.010 (0.009, 0.010)	included	< 0.002, < 0.002	T005593-07 W30CA078418

[a] Different periods

Rice

Twenty four supervised residue trials were conducted on rice in China during 2010 and 2011. Samples of rice (paddy plant, husk and grain) were stored deep-frozen for a maximum of 16 month and analysed by HPLC-FL. Only avermectin B_{1a} was analysed and the results reported as total abamectin. Summaries of the trial results are given in Table 78.

Table 78 Results from supervised trials conducted with abamectin on rice in China (Report AHKW-BG-012-2011)

Region year	Application rate, g ai/ha	DAT, days	Total abamectin residue, mg/kg
Anhui Province 2010	2× 14	14	< 0.001
		21	< 0.001
	3× 14	14	< 0.001
		21	< 0.001
	2× 20	14	< 0.001
		21	< 0.001
	3× 20	14	< 0.001
		21	< 0.001
Hunan Province 2010	2× 14	14	< 0.001
		21	< 0.001
	3× 14	14	< 0.001
		21	< 0.001
	2× 20	14	< 0.001
		21	< 0.001
	3× 20	14	< 0.001
		21	< 0.001
Guangxi Province 2010	2× 14	14 21	< 0.001 < 0.001
	3× 14	14 21	< 0.001 < 0.001
	2× 20	14 21	< 0.001 < 0.001
	3× 20	14 21	< 0.001 < 0.001
Anhui Province 2011	2× 14	14	< 0.001
		21	< 0.001
	3× 14	14	< 0.001
		21	< 0.001
	2× 20	14	< 0.001
		21	< 0.001

Region year	Application rate, g ai/ha	DAT, days	Total abamectin residue, mg/kg
	3× 20	14	0.005
		21	< 0.001
Hunan Province 2011	2× 14	14	0.002
		21	< 0.001
	3× 14	14	0.002
		21	< 0.001
	2× 20	14	0.004
		21	0.001
	3× 20	14	0.007
		21	0.003
Guangxi Province 2011	2× 14	14 21	< 0.001 < 0.001
	3× 14	14 21	< 0.001 < 0.001
	2× 20	14 21	0.002 < 0.001
	3× 20	14 21	0.005 < 0.001

Tree nuts

Thirty-two residue trials were conducted on almonds, pecans, and walnuts in the USA during the 1988 and 1989 growing seasons. Dry tree nut samples were stored deep-frozen for a maximum of 20 months and analysed by HPLC-FL. Summaries of the trial results are given in Table 79.

Table 79 Results from supervised trials conducted with abamectin on nuts in theUSA (Study 618-936-TRN)

Location year	Crop variety	Application rate, g ai/ha	Growth stage	DAT, days	Residues, mg/kg Avermectin B_{1a} + 8,9-Z-isomer	Avermectin B_{1b} + 8,9-Z-isomer	Trial
Fresno, CA 1988	Almond Non Pareil	3× 28	hull split	0 1 3	< 0.002 (4) < 0.002 (4) < 0.002 (4)	< 0.002 (4) < 0.002 (4) < 0.002 (4)	001-88-6028R
		3× 56	hull split	0 1 3	< 0.002 (4) < 0.002 (4) < 0.002 (4)	< 0.002 (4) < 0.002 (4) < 0.002 (4)	
Madeira, CA 1988	Almond Non Pareil	3× 28	hull split	0 1 3	< 0.002 (4) < 0.002 (4) < 0.002 (4)	< 0.002 (4) < 0.002 (4) < 0.002 (4)	001-88-6032R
		3× 56	hull split	0 1 3	< 0.002 (4) < 0.002 (4) < 0.002 (4)	< 0.002 (4) < 0.002 (4) < 0.002 (4)	
Stanislau, CA 1988	Almond Non Pareil	3× 28	hull split Post hull split	0 1 3 7 14	< 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4)	< 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4)	001-88-6034R
		3× 56	hull split Post hull Split	0 1 3 7 14	< 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4)	< 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4)	
Stanislau, CA 1988	Almond Non Pareil	3× 28	hull split	0 1 3	< 0.002 (4) < 0.002 (4) < 0.002 (4)	< 0.002 (4) < 0.002 (4) < 0.002 (4)	001-88-6035R
		3× 56	hull split	0 1 3 7 14	< 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4)	< 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4) < 0.002 (4)	

Location year	Crop variety	Application rate, g ai/ha	Growth stage	DAT, days	Residues, mg/kg Avermectin B_{1a} + 8,9-Z-isomer	Avermectin B_{1b} + 8,9-Z-isomer	Trial
				21	< 0.002 (4)	< 0.002 (4)	
Fresno, CA 1988	Walnut Franquette	3× 28	75% husk split	14	< 0.002 (4)	< 0.002 (4)	001-88-6027R
		2× 56	75% husk split	14	< 0.002 (4)	< 0.002 (4)	
Tulare, CA 1988	Walnut Serr	3× 30	10% husk split	14	< 0.002 (4)	< 0.002 (4)	001-88-6033R
		5× 59	10% husk split	14	< 0.002 (4)	< 0.002 (4)	
Stanislau, CA 1988	Walnut Chico	3× 28)	10% husk split	14	< 0.002 (4)	< 0.002 (4)	001-88-6038R
		3× 56	10% husk split	14	< 0.002 (4)	< 0.002 (4)	
San Benito, CA 1988	Walnut Payne	3× 28	80% husk split	14	< 0.002 (4)	< 0.002 (4)	001-88-6052R
		3× 56	80% husk split	14	< 0.002 (4)	< 0.002 (4)	
Colusa, CA 1989	Almond Mission	3× 28	hull split	0 14 21	< 0.002 (4) < 0.002 (4) < 0.002 (4)	< 0.002 (4) < 0.002 (4) < 0.002 (4)	001-89-6019R
Kern, CA 1989	Almond Mission	3× 28	hull split	0 14 21	< 0.002 (4) < 0.002 (4) < 0.002 (4)	< 0.002 (4) < 0.002 (4) < 0.002 (4)	001-89-6020R
Yolo, CA 1989	Walnut Hartley	3× 28	95% husk split	14	< 0.002 (4)	< 0.002 (4)	001-89-6034R
Stanislau, CA1989	Walnut Hartley	3× 28	Post full husk split	14	< 0.002 (4)	< 0.002 (4)	001-89-6035R
Jefferson, FL1988	Pecan Kiowa	3× 28	Pre shuck split	14	< 0.002 (4)	< 0.002 (4)	001-88-0033R
		3× 56	Pre shuck split	14	< 0.002 (4)	< 0.002 (4)	
Lee, AL 1988	Pecan Cheyanne	3× 28	Pre shuck split	18	< 0.002 (4)	< 0.002 (4)	001-88-0034R
		3× 56	Pre shuck split	18	< 0.002 (4)	< 0.002 (4)	
Mitchell, GA1988	Pecan Desirable	3× 28	Pre shuck split	14	< 0.002 (4)	< 0.002 (4)	001-88-0035R
		3× 56	Pre shuck split	14	< 0.002 (4)	< 0.002 (4)	
Zavalda, TX1988	Pecan Witchita	3× 28	90% shuck split	14	< 0.002 (4)	< 0.002 (4)	001-88-3017R
		3× 56	90% shuck split	14	< 0.002 (4)	< 0.002 (4)	
St. Francis, AZ 1988	Pecan Stuart	3× 28	Full shuck split	14	< 0.002 (4)	< 0.002 (4)	001-88-3023R
		3× 56	Full shuck split	14	< 0.002 (4)	< 0.002 (4)	
Mitchell, GA1989	Pecan Schley	3× 28	Full shuck split	14	< 0.002 (4)	< 0.002 (4)	001-89-0036R
Pinal, AR 1989	Pecan Western Schley	5× 28	Full shuck split	14	< 0.002 (4)	< 0.002 (4)	001-89-1029R

Cotton

Eight supervised trials were carried out on cotton in the 1999 and 2000 in Europe. Samples were stored deep-frozen for a maximum of 12 months and analysed by LC-MS/MS. Fourteen supervised trials were carried in 2008 and 2010 in the USA. Samples of undelinted seeds were stored deep-frozen for a maximum of 10 months, cotton meal was stored for a maximum of 7 months, gin by-products and refined oil for 14 months and cottonseed hulls for 6 months, and analysed by HPLC-FL. Summaries of the trial results are given in Table 80.

Table 80 Results from supervised trials conducted with abamectin on cotton

Country year	Cotton variety	Application rate, g ai/ha	Growth stage (BBCH)	DAT, days	Residues, mg/kg			Study; trial
					Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
Greece 1999	506 Stoneville	2× 18	81, 83	0 20	< 0.002(2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	1104/99
Greece 1999	506 Stoneville	2× 18	81 82	0 20	0.002 < 0.002 (2)	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	1105/99
Greece 2000	453 Stoneville	2× 18	83–84 86–87	0 3 7 14 20	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2)	1046/00; 1–Mavrogia
Greece 2000	453 Stoneville	2× 18	83–84 86–87	0 3 7 14 20	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2)	1047/00; 1–Ippodromos
Spain 1999	Crema 111	18, 17	87–89	0 20	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	< 0.002 (2) < 0.002 (2)	1114/99
Spain 1999	Carmen	2× 18	87–89	0 3 7 14 20	0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2)	1115/99
Spain 2000	Crema	2× 18	87	0 3 7 14 20	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2)	1088/00 Alcalá del Río
Spain 2000	Crema	2× 18	87	0 3 7 14 20	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2)	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002 (2)	1089/00; Alcalá del Río
USA Suffolk, VA, 2008	PHY 370 WR	2× 21	79, 93	20	< 0.002 (2)	included	< 0.002 (2)	T005597-07; E07VA081021
USA Proctor, AR 2008	DG2215B2RF	2× 21	mature —50% opening	20	< 0.002 (2)	included	< 0.002 (2)	T005597-07; C24AR081022
USA Proctor, AR 2008	DG2215B2RF	2× 21	mature —50% opening	10 15 20 25 30	< 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2)	included	< 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2) < 0.002 (2)	T005597-07; C24AR081023
USA Uvalde, TX	DPL 434	2× 21	82, 86	20	< 0.002 (2)	included	< 0.002 (2)	T005597-07; W07TX0810
		2×106	82, 86	20	< 0.002,	included	< 0.002 (3)	24

Country year	Cotton variety	Application rate, g ai/ha	Growth stage (BBCH)	DAT, days	Residues, mg/kg			Study; trial
					Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
2008					0.009, 0.002			
USA Levelland, TX 2008	FM9063B2F	21, 22	90% size 25% opening	20	< 0.002 (2)	included	< 0.002 (2)	T005597-07; W39TX081025
USA Groom, TX 2008	2326RF	21, 22	81, 74	20	0.005 (< 0.002, 0.008)	included	< 0.002 (2)	T005597-07; E13TX08102
		107, 108	81, 74	20	0.015, 0.010, 0.011	included	< 0.002 (3)	6
USA Claude, TX 2008	NexGen 3554RF	2× 22	80, 72	20	< 0.002 (2)	included	< 0.002 (2)	T005597-07; E13TX081027
USA Fresno, CA 2008	PHY 755 WRF Acala	2× 21	80, 82	20	0.010 (0.010, 0.011)	included	< 0.002 (2)	T005597-07; W30CA081028
USA Madera, CA 2008	Acala Riata Roundup Ready	2× 21	< 1 to 10% opening	20	< 0.002 (2)	included	< 0.002 (2)	T005597-07; W29CA081029
USA LA, 2010	Phytogen 485 WRF	21, 22	5–70% open	20	< 0.002 (2)	included	< 0.002 (2)	TK0023918; E17-0011
USA TX, 2010	Stoneville 5458B2RF	2× 21	77, 87	20	< 0.002 (2)	included	< 0.002 (2)	TK0023918; W07-0012
USA CA, 2010	PHY725RF	2× 21	77, 86	20	< 0.002 (2)	included	< 0.002 (2)	TK0023918; W28-0014

Peanuts

Four supervised residue trials were conducted on peanuts in Brazil during the growing seasons of 2009. Peanut seed samples were stored deep-frozen for a maximum of 5.7 months and analysed by HPLC-FL. Residue data from supervised trials on peanut are summarized in Table 81.

Table 81 Results from supervised trials conducted with abamectin on peanuts in Brazil in 1999 (Report: M09044)

Location	Peanut variety	Application rate, g ai/ha	Growth stage (BBCH)	DAT (days)	Residues, mg/kg		Trial
					Avermectin B_{1a} + 8,9-Z-isomer	Avermectin B_{1b}	
Minas Gerais	Tatu	3× 14	91, 93, 95	7 14 21	< 0.005 < 0.005 < 0.005	< 0.003 < 0.003 < 0.003	JJB
Paraná	Tatu	3× 14	73, 77, 81	7 14 21	< 0.005 < 0.005 < 0.005	< 0.003 < 0.003 < 0.003	LZF1
São Paulo, Eng. Coelho	Tatu	3× 14	71–73, 75–77 81–85	7 14 21	< 0.005 < 0.005 < 0.005	< 0.003 < 0.003 < 0.003	LZF2
São Paulo, Jaboticabal	Alto Oleico	3× 14	75, 77, 79	7 14 21	< 0.005 < 0.005 < 0.005	< 0.003 < 0.003 < 0.003	LZF3

Coffee

Five supervised residue trials were conducted on coffee in Brazil during the growing seasons 2009 and 2010. Coffee (bean) samples were stored deep-frozen for a maximum of 5.1 months and analysed by HPLC-FL or LC-MS/MS. Residue data from supervised trials on coffee are summarized in Table 82.

Table 82 Results from supervised trials conducted with abamectin on coffee in Brazil

Location year	Coffee variety	Application rate, g ai/ha	Growth stage BBCH	DAT, days	Residues, mg/kg			Study; trial
					Abamectin B_{1a}	B_{1a} 8,9-Z-isomer	Abamectin B_{1b}	
Minas Gerais 2009	Catuat	7.2	88	7 14 21	< 0.002 < 0.002 < 0.002	included	< 0.001 < 0.001 < 0.001	M09030;JJB
Monte Carmelo, MG 2010	Munda Nova	9.0	91	7 14 21	< 0.001 < 0.001 < 0.001	< 0.001 < 0.001 < 0.001	< 0.0004 < 0.0004 < 0.0004	M10031;JJB1
Indianopolis, MG 2010	Munda Nova	9.0	85	7 14 21	< 0.001 < 0.001 < 0.001	< 0.001 < 0.001 < 0.001	< 0.0004 < 0.0004 < 0.0004	M10031;JJB2
E. S. do Dourado, MG 2010	Munda Nova	9.0	83	7 14 21	< 0.001 < 0.001 < 0.001	< 0.001 < 0.001 < 0.001	< 0.0004 < 0.0004 < 0.0004	M10031;LZF
Parana 2010	IAPAR 59	9.0	89	7 14 21	< 0.001 < 0.001 < 0.001	< 0.001 < 0.001 < 0.001	< 0.0004 < 0.0004 < 0.0004	M10031;AMA

Hops

Eight supervised field trials on hops were conducted in Germany and four in the USA in 1994 and 1996. Samples were stored deep-frozen for a maximum of 6 months and analysed by HPLC-FL. Summaries of the trial results are given in Table 83.

Table 83 Results from supervised trials conducted with abamectin on hops

Country year	Hop variety	Application rate, g ai/ha	Growth stage BBCH	DAT, days	Crop Part	Residues, mg/kg		Study; trial
						Avermectin B_{1a} + 8,9-Z-isomer	Avermectin B_{1b} + 8,9-Z-isomer	
Germany (Tettnang) 1994	Hallertauer Frühreifer	24, 23	47 75	0 29 29	green cones dried cones cones	0.152, 0.136 <u>0.012</u> (0.011, 0.012) < 0.005 (2)	0.010, 0.009 < 0.005 (2) < 0.005 (2)	E-96-MK-936-HOP; 072-96-0011R
Germany (Pfaffenhofen) 1994	Hersbrucker	22, 23	51 75	0 30 30	green cones dried cones cones	0.172, 0.283 < 0.005 (2) < 0.005 (2)	0.011, 0.019 < 0.005 (2) < 0.005 (2)	E-96-MK-936-HOP; 072-96-0012R
Germany (Pfaffenhofen) 1994	Perle	22, 23	51 75	0 30 30	green cones dried cones cones	0.225, 0.221 <u>0.010</u> (0.009, 0.011) < 0.005, 0.008	0.015, 0.015 < 0.005 (2) < 0.005 (2)	E-96-MK-936-HOP; 072-96-0013R
Germany (Weibensee) 1994	Northern Brewer	23, 21	80% height 71–75	0 28 28	green cones dried cones cones	0.120, 0.101 <u>< 0.005</u> (2) < 0.005 (2)	0.008, 0.007 < 0.005 (2) < 0.005 (2)	E-96-MK-936-HOP; 072-96-0014R
Germany 1994	Hallertauer Tradition	2× 22	full height	0 14 20 21 27 28	green cones green cones green cones dried	0.231, 0.213 0.011, 0.008 0.008, 0.006 0.029, 0.031 0.006, 0.006 <u>0.021</u> (0.022, 0.020)	0.026, 0.022 < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.005 (2)	E-94-MK-936-HOP; 072-94-0005R

Country year	Hop variety	Application rate, g ai/ha	Growth stage BBCH	DAT, days	Crop Part	Residues, mg/kg		Study; trial
						Avermectin B_{1a} + 8,9-Z-isomer	Avermectin B_{1b} + 8,9-Z-isomer	
					cones green cones dried cones			
		24, 22	full height full height	0 14 20 21 27 28	green cones green cones green cones dried cones green cones dried cones	0.441, 0.817 0.022, 0.016 0.010, 0.012 0.031, 0.024 0.007, 0.006 0.022, 0.012	0.049, 0.087 < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.005 (2)	
Germany 1996	Hop (Perle)	23, 21	full height full height	0 14 20 21 27 28	green cones green cones green cones dried cones green cones dried cones	0.246, 0.292 0.015, 0.011 0.005, 0.006 0.034, 0.029 < 0.005, 0.006 0.025, 0.020	0.026, 0.031 < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.005 (2)	E-94-MK-936-HOP; 072-94-0007R
		23, 21	full height full height	0 14 20 21 27 28	green cones green cones green cones dried cones green cones dried cones	0.204, 0.348 0.016, 0.009 0.010, 0.006 0.035, 0.036 0.005, 0.006 <u>0.028</u> (0.030, 0.025)	0.021, 0.037 < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.005 (2)	
Germany 1994	Hop (Perle)	24, 22	full height full height	0 14 20 21 27 28	green cones green cones green cones dried cones green cones dried cones	0.225, 0.307 0.011, 0.018 0.008, 0.010 0.043, 0.041 < 0.005 (2) <u>0.020</u> (0.017, 0.022)	0.024, 0.031 < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.005 (2)	E-94-MK-936-HOP; 072-94-0006R
		23, 22	full height full height	0 14 20 21 27 28	green cones green cones green cones dried cones	0.400, 0.276 0.014, 0.011 0.010, 0.013 0.046, 0.044 0.006, 0.005 0.017, 0.012	0.036, 0.027 < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.0025 (2)	

Country year	Hop variety	Application rate, g ai/ha	Growth stage BBCH	DAT, days	Crop Part	Residues, mg/kg		Study; trial
						Avermectin B_{1a} + 8,9-Z-isomer	Avermectin B_{1b} + 8,9-Z-isomer	
					green cones dried cones			
Germany 1994	Hallertauer Mittelfrüh	22, 21	80% of full height full height	0 14 21 22 28 28	green cones green cones green cones dried cones dried cones green cones	0.113, 0.121 < 0.005 (2) < 0.005 (2) 0.004, 0.005 <u>< 0.005</u> (2) < 0.005 (2)	0.010, 0.012 < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.005 (2)	E-94-MK-936-HOP; 072-94-0008R
		23, 22	80% of full height–full height	0 14 21 22 28 28	green cones green cones green cones dried cones dried cones green cones	0.238, 0.306 < 0.005 (2) < 0.005 (2) 0.004, 0.007 < 0.005 (2) < 0.005 (2)	0.025, 0.030 < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.005 (2) < 0.005 (2)	
Yakima, WA USA 1994	Galena	2× 21	18 ft	0 27	dried cones dried cones	0.59, 0.73 <u>0.061</u> (0.044, 0.078)	0.059, 0.073 < 0.005, 0.008	618-936-94035; 001-94-1005R
Ganger, WA USA 1994	Cluster	2× 21	early maturity	0 28	dried cones dried cones	0.16, 0.15 <u>0.20</u> (0.017, 0.023)	0.015, 0.015 < 0.005 (2)	618-936-94035; 001-94-1006R
ID, USA 1994	Galena	20, 22	5.2–5.5 m	0 28	dried cones dried cones	0.67, 0.59 <u>0.056</u> (0.055, 0.057)	0.072, 0.064 < 0.005 (2)	618-936-94035; 001-94-1007R
OR, USA 1994	Nugget	22, 21	5.5 m	0 28	dried cones dried cones	0.97, 0.81 <u>0.012</u> (0.009, 0.015)	0.096, 0.081 < 0.005 (2)	618-936-94035; 001-94-1008R

Feed commodities

Some trials from the studies reported previously have include the analysis of feed samples. The results are shown in Tables 84 to 91.

Table 84 Results from supervised trials conducted with abamectin on rice in China (Report AHKW-BG-012-2011). The paddy rice plant is whole plant cut just above soil level (including grain and husk).

Region	Application rate, g ai/ha	DAT (days)	Crop Part	Avermectin B1a + its 8,Z isomer, mg/kg
Anhui Province 2010	20	0.08 0.25 1	paddy plant paddy plant paddy plant	0.361 0.309 0.069

Region	Application rate, g ai/ha	DAT (days)	Crop Part	Avermectin B1a + its 8,Z isomer, mg/kg
		3 5 7 14 21 30	paddy plant paddy plant paddy plant paddy plant paddy plant paddy plant	0.017 0.010 0.004 0.001 < 0.001 < 0.001
	2x14	14	paddy plant husk	< 0.001 < 0.001
		21	paddy plant husk	< 0.001 < 0.001
	3× 14	14	paddy plant husk	< 0.001 < 0.001
		21	paddy plant husk	< 0.001 < 0.001
	2x 20	14	paddy plant husk	0.002 0.006
		21	paddy plant husk	< 0.001 < 0.001
	3x20	14	paddy plant husk	0.003 0.018
		21	paddy plant husk	< 0.001 < 0.001
Hunan Province	20	0.08 0.25 1 3 5 7 14 21 30	paddy plant paddy plant paddy plant paddy plant paddy plant paddy plant paddy plant paddy plant paddy plant	0.698 0.452 0.074 0.025 0.009 0.006 < 0.001 < 0.001 < 0.001
	2× 14	14	paddy plant husk	< 0.001 < 0.001
		21	paddy plant husk	< 0.001 < 0.001
	3× 14	14	paddy plant husk	< 0.001 0.005
		21	paddy plant husk	< 0.001 < 0.001
	2× 20	14	paddy plant husk	< 0.001 0.006
		21	paddy plant husk	< 0.001 < 0.001
	3x 20	14	paddy plant husk	0.001 0.009
		21	paddy plant husk	0.001 < 0.001
Guangxi Province	20	0.08 0.25 1 3 5 7 14 21 30	paddy plant paddy plant paddy plant paddy plant paddy plant paddy plant paddy plant paddy plant paddy plant	0.142 0.140 0.086 0.048 0.012 0.004 0.001 < 0.001 < 0.001
	2× 14	14 14 21 21	paddy plant husk paddy plant husk	0.009 < 0.001 < 0.001 < 0.001
	3× 14	14 14 21	paddy plant husk paddy plant	0.019 < 0.001 < 0.001

Region	Application rate, g ai/ha	DAT (days)	Crop Part	Avermectin B1a + its 8,Z isomer, mg/kg
		21	husk	< 0.001
	2x20	14 14 21 21	paddy plant husk paddy plant husk	0.0171 0.0073 < 0.001 < 0.001
	3x 20	14 14 21 21	paddy plant husk paddy plant husk	0.033 0.018 < 0.001 < 0.001
Anhui Province	20	0.08 0.25 1 3 5 7 14 21 30	paddy plant paddy plant paddy plant paddy plant paddy plant paddy plant paddy plant paddy plant paddy plant	1.983 1.184 0.272 0.108 0.025 0.006 < 0.001 < 0.001 < 0.001
	2× 14	14	paddy plant husk	< 0.001 0.008
		21	paddy plant husk	< 0.001 < 0.001
	2× 14	14	paddy plant husk	0.004 0.012
		21	paddy plant husk	< 0.001 < 0.001
	2x20	14	paddy plant husk	0.003 0.008
		21	paddy plant husk	< 0.001 < 0.001
	3x20	14	paddy plant husk	0.009 0.025
		21	paddy plant husk	< 0.001 < 0.001
Hunan Province	20	0.08 0.25 1 3 5 7 14 21 30	paddy plant paddy plant paddy plant paddy plant paddy plant paddy plant paddy plant paddy plant paddy plant	0.743 0.484 0.080 0.027 0.009 0.007 < 0.001 < 0.001 < 0.001
	2× 14	14	paddy plant husk	< 0.001 < 0.001
		21	paddy plant husk	< 0.001 < 0.001
	3× 14	14	paddy plant husk	< 0.001 0.006
		21	paddy plant husk	< 0.001 < 0.001
	2× 20	14	paddy plant husk	< 0.001 0.009
		21	paddy plant husk	< 0.001 < 0.001
	3× 20	14	paddy plant husk	0.001 0.022
	2× 20	21	paddy plant husk	< 0.001 < 0.001
Guangxi Province	20	0.08 0.25 1 3	paddy plant paddy plant paddy plant paddy plant	0.683 0.387 0.112 0.107

Region	Application rate, g ai/ha	DAT (days)	Crop Part	Avermectin B1a + its 8,Z isomer, mg/kg
		5	paddy plant	0.021
		7	paddy plant	0.003
		14	paddy plant	< 0.001
		21	paddy plant	< 0.001
		30	paddy plant	< 0.001
	2× 14	14	paddy plant	< 0.001
		14	husk	0.008
		21	paddy plant	< 0.001
		21	husk	0.006
	3× 14	14	paddy plant	0.007
		14	husk	0.010
		21	paddy plant	0.004
		21	husk	0.008
	2× 20	14	paddy plant	0.010
		14	husk	0.009
		21	paddy plant	< 0.001
		21	husk	0.008
	3× 20	14	paddy plant	0.019
		14	husk	0.016
		21	paddy plant	0.006
		21	husk	0.015

Table 85 Results from supervised trials conducted with abamectin on green beans, remaining plant (vines) (CEMS-3913; 2008)

Country	Bean variety	Application rate, g ai/ha	Growth stage	DAT, days	Residues, mg/kg			Trial
					Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
France	Booster	23, 23, 22	65–81	–0	0.279	< 0.002	0.007	S08-00832-01
				0	0.497	< 0.002	0.014	
				1	0.485	< 0.002	0.034	
				3	0.354	< 0.002	0.009	
				7	0.329	< 0.002	0.008	
	Booster	23, 22	65–83	–0	0.270	< 0.002	0.006	
				0	0.803	< 0.002	0.020	
				1	0.478	< 0.002	0.011	
				3	0.255	< 0.002	0.006	
				7	0.231	< 0.002	0.006	
Italy	Oriente	23, 20, 22	76–83	–0	0.031	< 0.002	0.002	S08-00832-02
				0	0.765	< 0.002	0.064	
				1	0.130	< 0.002	0.010	
				3	0.326	< 0.002	0.025	
				7	0.169	< 0.002	0.012	
	Oriente	22, 21	77–83	–0	0.056	< 0.002	0.004	
				0	0.471	< 0.002	0.041	
				1	0.620	< 0.002	0.047	
				3	0.329	< 0.002	0.024	
				7	0.198	< 0.002	0.014	
Spain	Emerite	22, 22, 21	71–85	–0	0.278	< 0.002	0.019	S08-00832-03
				0	0.487	< 0.002	0.012	
				1	0.556	< 0.002	0.040	
				3	0.581	< 0.002	0.040	
				7	0.435	< 0.002	0.031	
	Emerite	2× 22	72, 85		0.165	< 0.002	0.010	
				0	1.019	< 0.002	0.078	
				1	0.514	< 0.002	0.037	
				3	0.413	< 0.002	0.029	
				7	0.364	< 0.002	0.026	
Spain	Killy	20, 22, 22	76-77	–0	0.341	< 0.002	0.025	S08-00832-04
				0	0.572	< 0.002	0.049	
				1	0.531	< 0.002	0.015	
				3	0.349	< 0.002	0.023	
				7	0.250	< 0.002	0.015	

Country	Bean variety	Application rate, g ai/ha	Growth stage	DAT, days	Residues, mg/kg			Trial
					Avermectin B_{1a}	B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	
	Killy	22, 21	76, 77	–0 0 1 3 7	0.162 0.733 0.350 0.290 0.161	< 0.002 < 0.002 < 0.002 < 0.002 < 0.002	0.011 0.063 0.024 0.019 0.010	

Table 86 Results from supervised trials conducted with abamectin on almonds in the USA, showing the residues in almond hulls

Region year	Almond variety	Application rate, g ai/ha	Growth stage	DAT, days	Residues, mg/kg		Study; trial
					Avermectin B_{1a}+ 8,9-Z-isomer	B_{1b} + 8,9-Z-isomer	
Fresno, CA 1988	Non Pareil	3× 28	hull split	0 21	0.006, 0.005, 0.009, 0,016 < 0.002 (4)	< 0.002 (4) < 0.002 (4)	618-936-TRN; 001-88-6028R
		3× 58	hull split	0 21	0.026, 0.022, 0.048, 0.041 < 0.005 (4)	< 0.005 (4) < 0.002 (4)	
Madera, CA 1988	Non Pareil	3× 28	hull split	0 3 7 14 21	0.218, 0.225 0.238, 0.266 0.095, 0.046 0.078, 0.070 0.083, 0.055 0.053, 0.061 0.037 (2), 0.046, 0.047 0.035 (0.042, 0.030 (2), 0.038)	0.021, 0.027 0.025, 0.030 0.010, 0.005 0.010, 0.008 0.009, 0.007 0.007, 0.007 < 0.005 (4) < 0.005 (4)	618-936-TRN; 001-88-6032R
		3× 56	hull split	0 3 7 14 21	0.536, 0.642, 0.598, 0.676 0.233, 0.235, 0.305, 0.334 0.142, 0.193, 0.232, 0.178 0.144, 0.114, 0.190, 0.194 0.080, 0.107, 0.149, 0.166	0.063, 0.067, 0.066, 0.072 0.280 (2), 0.037, 0.038 0.014, 0.021(2), 0.026 0.016, 0.013, 0.020, 0.022 0.008, 0.011, 0.018 (2)	
Stanislaus, CA 1988	NonPareil	3× 28	hull split Post hull Split	0 21	0.264, 0.321, < 0.306, 0.347 0.110 (0.070, 0.055, 0.032, 0.281)	0.030, 0.034, 0.280, 0.035 0.007, 0.006, < 0.005 (2)	618-936-TRN; 001-88-6034R
		3× 56	hull split Post hull Split	0 21	0.571, 1.096, 0.749, 1.029 0.157, 0.122, 0.098, 0.136	0.052, 0.104, 0.071, 0.100 0.016, 0.012, 0.010, 0.013	
Stanislaus, CA 1988	NonPareil	3× 28	hull split	0 21	0.064, 0.201, 0.010, 0.179 0.037 (0.031, 0.053, 0.026, 0.041)	0.007, 0.022, 0.012, 0.019 < 0.005 (3), 0.006	618-936-TRN Trial: 001-88-6035R
		3× 56	hull split	0 21	0.198, 0.261, 0.220, 0.619 0.088, 0.113, 0.116, 0.216	0.022, 0.281, 0.023, 0.068 0.008, 0.011, 0.015, 0.023	
Colusa, CA 1989	Mission	3× 28	hull split	0 14 21	0.108, 0.091, 0.046, 0.101 0.016, 0.018, 0.011, 0.017 0.012 (0.012, 0.013, 0.010 0.016)	0.030, 0.015 (2), 0.006 < 0.002 (4) < 0.002 (4)	618-936-TRN Trial: 001-89-6019R

Region year	Almond variety	Application rate, g ai/ha	Growth stage	DAT, days	Residues, mg/kg		Study; trial
					Avermectin B_{1a}+ 8,9-Z-isomer	B_{1b} + 8,9-Z-isomer	
Kern, CA 1989	Mission	3× 28	hull split	0 14 21	0.101, 0.204, 0.162, 0.174 0.029, 0.052, 0.021, 0.046 0.102 (0.280, 0.006, 0.021)	0.013, 0.026, 0.020, 0.022 0.005, 0.007, < 0.005, 0.008 < 0.005 (2), < 0.002	618-936-TRN Trial: 001-89-6020R

Table 87 Results from supervised trials conducted with abamectin on cotton hulls in Europe

Country year	Cotton variety	Application rate, g ai/ha	Growth stage (BBCH)	DAT, days)	Residue Found (mg/kg)				Study; trial
					Avermectin B_{1a}	Avermectin B_{1a} 8,9-Z-isomer	Avermectin B_{1b}	Total residue	
Greece 1999	Stoneville	2× 18	81–83	0 20	0.005(2) < 0.005 (2)	0.005 (2) < 0.005 (2)	0.005 (2) < 0.005 (2)	0.015 < 0.015	1104/99
Greece 1999	Stoneville	2× 18	81–82	0 20	0.008(2) < 0.005(2)	< 0.005 (2) < 0.005 (2)	< 0.005 (2) < 0.005 (2)	0.018 < 0.015	1105/99
Spain 1999	Crema 11	17, 18	87–89	0 20	0.007,< 0.005 < 0.002(2)	< 0.005 (2) < 0.002 (2)	< 0.005 (2) < 0.002 (2)	0.016 < 0.006	1114/99
Spain 1999	Carmen	2× 18	87–89	0 3 7 14 20	0.014 < 0.005 < 0.005 < 0.005 < 0.005 (2)	< 0.005 < 0.005 < 0.005 < 0.005 < 0.005 (2)	< 0.005 < 0.005 < 0.005 < 0.005 < 0.005 (2)	0.024 < 0.015 < 0.015 < 0.015 < 0.015	1115/99
Greece 2000	Stoneville	2× 18	83–87	0 3 7 14 20	0.007 < 0.005 < 0.005 < 0.005 < 0.005 (2)	< 0.005 < 0.005 < 0.005 < 0.005 < 0.005 (2)	< 0.005 < 0.005 < 0.005 < 0.005 < 0.005 (2)	0.017 < 0.015 < 0.015 < 0.015 < 0.015	1046/00; Mavrogia
Greece 2000	Stoneville	2× 18	83–87	0 3 7 14 20	0.007 < 0.005 < 0.005 < 0.005 < 0.005 (2)	< 0.005 < 0.005 < 0.005 < 0.005 < 0.005 (2)	< 0.005 < 0.005 < 0.005 < 0.005 < 0.005 (2)	0.017 < 0.015 < 0.015 < 0.015 < 0.015	1047/00; Ippodromos
Spain 2000	Crema	2× 18	87	0 3 7 14 20	0.009 < 0.005 < 0.005 < 0.005 < 0.005 (2)	< 0.005 < 0.005 < 0.005 < 0.005 < 0.005 (2)	< 0.005 < 0.005 < 0.005 < 0.005 < 0.005 (2)	0.019 < 0.015 < 0.015 < 0.015 < 0.015	1088/00
Spain 2000	Crema	2× 18	87	0 3 7 14 20	0.010 < 0.005 < 0.005 < 0.005 < 0.005 (2)	< 0.005 < 0.005 < 0.005 < 0.005 < 0.005 (2)	< 0.005 < 0.005 < 0.005 < 0.005 < 0.005 (2)	0.020 < 0.015 < 0.015 < 0.015 < 0.015	1089/00; Alcalá del Río

Fate of Residues in Processing

Four processing studies were conducted with grapes, yielding raisins, pomace, and juice, and two in plums, yielding prunes. The results are shown in Table 89. All the studies were conducted within the supervised trials. Grape processed commodities were analysed within a month after being produced.

Table 88 Processing studies of abamectin in grapes and plums

Matrix	Avermectin B_{1a} + 8,9-Z-isomer, mg/kg (mean)	Avermectin B_{1b} + 8,9-Z-isomer, mg/kg (mean)	Total residue, mg/kg	Processing factor	Study; trial
Grape fruit	0.010	< 0.002	0.012		618-244-94036; 001-94-5006R
washed fruit	0.013	< 0.002	0.015	1.25	
raisin	0.0095	< 0.002	0.012	1	
juice	< 0.002	< 0.001	< 0.003	< 0.25	

Matrix	Avermectin B_{1a} + 8,9-Z-isomer, mg/kg (mean)	Avermectin B_{1b} + 8,9-Z-isomer, mg/kg (mean)	Total residue, mg/kg	Processing factor	Study; trial
pomace, wet	0.052	0.006	0.057	4.75	
pomace, dry	0.164	0.018	0.189	15.8	
waste	0.0121	0.001	0.013	1.1	
waste	0.022	0.002	0.024	2	
Grape fruit	0.0053	< 0.002	0.007		T005598-07; E03NY081041
raisin	0.020	< 0.002	0.022	3.1	
juice	< 0.002	< 0.002	< 0.004	< 0.57	
Grape fruit	0.046	< 0.002	0.048		T005598-07; W26CA081043
raisin	0.133	< 0.002	0.135	2.8	
juice	0.067	< 0.002	0.069	1.4	
Plum	0.0035	< 0.001	0.005		ABR-98073; 001-96-4011R
prune	0.003	< 0.001	0.004	0.8	
Plum	< 0.001	< 0.001	< 0.002		ABR-98073; 001-96-4014R
prune	0.003	< 0.001	0.004	2	

Eleven processing studies were conducted with cotton, four in Europe and two in USA. The results are shown in Table 89. All the studies were conducted within the supervised trials for the main crop. Processing factors were not calculated when residues in the raw commodity was < LOQ.

Table 89 Results from processing studies conducted with abamectin on cotton

Matrix	Avermectin B_{1a} + 8,9-Z-isomer, mg/kg (mean)	Avermectin B_{1b} + 8,9-Z-isomer (mean)	Total abamectin, mg/kg	Processing factor	Study; trial
Seed	< 0.004	< 0.002	< 0.006		1104/99
press cake	< 0.004	< 0.002	< 0.006	1	
crude oil	< 0.004	< 0.002	< 0.006	1	
Seed	< 0.004	< 0.002	< 0.006		1105/99
press cake	< 0.004	< 0.002	< 0.006	1	
crude oil	< 0.004	< 0.002	< 0.006	1	
Seed	< 0.004	< 0.002	< 0.006		1046/00
press cake	< 0.004	< 0.002	< 0.006	1	
crude oil	0.002	< 0.002	0.006	–	
Seed	< 0.004	< 0.002	< 0.006		1047/00
press cake	< 0.004	< 0.002	< 0.006	1	
crude oil	< 0.004	< 0.002	< 0.006	1	
Seed	0.004	< 0.002	0.006		T005597-07;
meal	< 0.002	< 0.002	< 0.004	< 0.67	W07TX081024
refined oil	< 0.002	< 0.002	< 0.004	< 0.67	
Seed	< 0.002	< 0.002	< 0.004		
gin trash	0.015	< 0.002	0.017	–	
Seed	0.012	< 0.002	0.014		T005597-07;
meal	< 0.002	< 0.002	< 0.004	< 0.028	E13TX081026
refined oil	< 0.002	< 0.002	< 0.004	< 0.028	
Seed	0.005	< 0.002	0.007		
gin trash	0.121	0.002	0.123	–	
Seed	< 0.02	< 0.002	< 0.004		T005597-07;
gin trash	0.010	< 0.002	0.013	–	C24AR081022
Seed	< 0.02	< 0.002	< 0.004		T005597-07;
gin trash	0.012	< 0.002	0.014	–	W39TX081025
Seed	< 0.002	< 0.002	< 0.004		T005597-07;
gin trash	0.014	< 0.002	0.017	–	E13TX081027
Seed	0.011	< 0.002	0.013		T005597-07;
gin trash	0.625	0.0035	0.63	48.5	W30CA081028
Seed	< 0.002	< 0.002	< 0.004		TK0023918;
gin trash	0.0785	< 0.002	0.080	–	W07-0012

Livestock feeding studies

A feeding study in dairy cows was performed (Wehner, 1986). Twelve lactating Holstein cows were assigned to four dosing level groups (0, 0.01, 0.03 and 0.10 ppm), administered daily in gelatin capsules for 28–30 days. Milk samples were collected pre-dose, Day 1 (a.m. and p.m.), 2, 3, 5, 7, 14, and 28 (a.m. and p.m.) and liver, kidney, fat, muscle collected at sacrifice. Milk and tissue samples were analysed by HPLC-FL for avermectin B_{1a}, with an LOQ of 0.0005 mg/kg in milk and 0.01 mg/kg in tissues. The results are shown in Table 90. Levels of avermectin B_{1a} were highest in liver at all three feeding rates.

Table 90 Avermectin B_{1a} residues in tissues of treated cows

Matrix	Feeding level, ppm	Range, mg/kg	Mean, mg/kg
Muscle	0.10	0.002–0.002	0.002
Muscle	0.03	0.002–0.002	0.002
Muscle	0.01	0.001–0.002	0.002
Fat	0.10	0.0098–0.014	0.012
Fat	0.03	0.004–0.006	0.005
Fat	0.01	0.002–0.002	0.002
Liver	0.10	0.018–0.020	0.019
Liver	0.03	0.005–0.0076	0.0065
Liver	0.01	0.003–0.004	0.003
Kidney	0.10	0.004–0.005	0.004
Kidney	0.03	0.002–0.002	0.002
Kidney	0.01	0.001–0.002	0.001

Residues in control was 0.001 mg/kg in liver, fat and kidney and < 0.001 mg/kg in muscle

Residues of avermectin B_{1a} in milk are shown in Table 91. Maximum residues in milk at the highest feeding rate reached 0.004 mg/kg (Day 14).

Table 91 Residues of avermectin B_{1a} in milk from treated cows

	0.01 ppm (1×)		0.03 ppm (3×)		0.10 ppm (10×)	
Sampling time	Mean	Maximum	Mean	Maximum	Mean	Maximum
Pre-dose a.m.	–	–	–	–	(< 0.0005)	(< 0.0005)
Pre-dose p.m.	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Day 1 a.m.	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Day 1 p.m.	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Day 2 p.m.	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.001
Day 3 p.m.	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.001
Day 5 p.m.	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.001
Day 7 p.m.	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.001	0.002
Day 14 p.m.	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.002	0.004
Day 28 a.m.	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.001	0.001
Day 28 p.m.	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.001	0.001
Overall	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.004

Results in brackets are single determinations

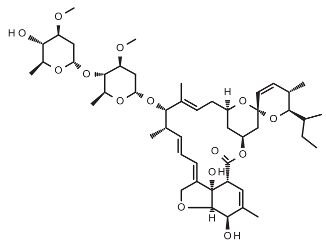
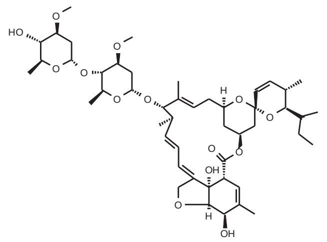
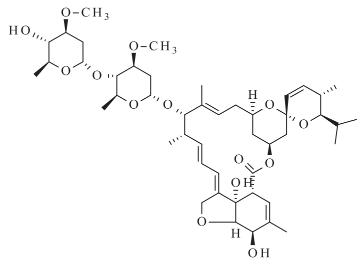
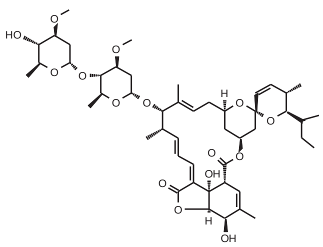
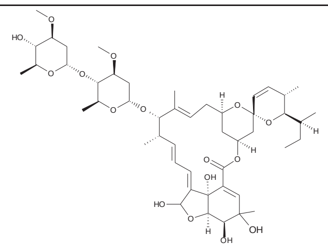
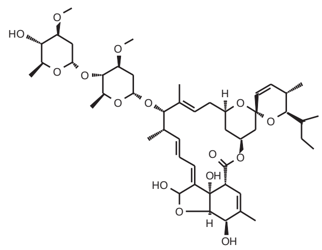
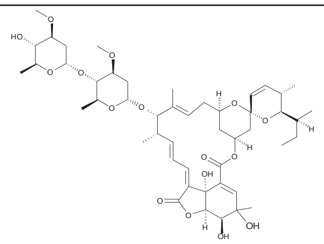
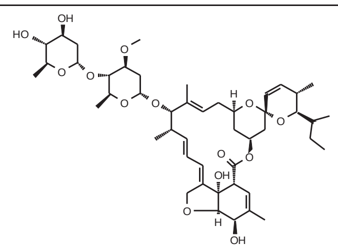
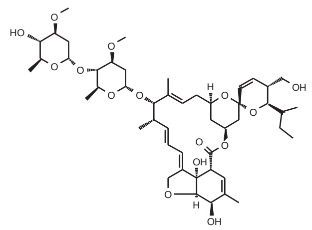
APPRAISAL

Abamectin is a broad-spectrum acaricide with additional insecticidal action on a limited number of insects. Abamectin was firstly evaluated by JMPR in 1992 (T,R), and was scheduled at the Forty-sixth Session of the CCPR (2014) for the periodic re-evaluation of toxicology and residues by the 2015 JMPR. For the residue evaluation, data were submitted on physical and chemical properties, environmental fate, metabolism on plants and lactating goats, analytical methods, GAP, supervised trials on fruits, vegetables, nuts, beans, coffee, cotton and cereals, processing studies and cow feeding studies.

Abamectin is a mixture containing ≥ 80% avermectin B_{1a} and ≤ 20% avermectin B_{1b}. The absolute stereochemistry of both compounds is known and defined at each chiral centre and stereogenic carbon-carbon double bond by their IUPAC nomenclature. Abamectin (> 98% purity) has a low solubility in water (1.2 mg/L at 7.6 pH and 25 °C), is soluble in most organic solvents (23 g/L in toluene up to 470 g/L in ethyl acetate) and has a log K_{ow} of 4.4.

Abamectin is also used as an anthelmintic drug in veterinary medicine. The JECFA residue definition for the compound is avermectin B_{1a}.

The abamectin structures and the main metabolites and degradates found in water, soil, plants and animals are shown below.

 Avermectin B_{1a}	 8,9-Z isomer of avermectin B_{1a}	 Avermectin B_{1b}
 8α-oxo-avermectin B_{1a}	 4,8α-dihydroxy-avermectin B_{1a}	 8α-hydroxy-avermectin B_{1a}
 8α-oxo-4-hydroxy-avermectin B_{1a}	 3''-O-desmethyl-avermectin B_{1a}	 (24-hydoxymethyl) avermectin B_{1a}

Environmental fate

Various studies were conducted to evaluate the aerobic degradation of [^{14}C- an/or ^{3}H-] avermectin B_{1a} in different non-sterile soils in the dark under various conditions (application rate, temperature and water capacity) over a period of up to 196 days. Avermectin B_{1a} degraded in soils with a half-life ranging from 12 to 52 days, and a mean of 29 ± 14 days (n=14). The degradation pathway occurs via hydroxylation or oxidation in the C-8α position, with 8α-hydroxy-avermectin B_{1a} being the major metabolite (up to 18% of the applied radioactivity, AR), present as an equilibrium mixture between the hemiacetal and the ring cleaved aldehyde form. The oxidation product 8α-oxo-avermectin B_{1a} was found at a maximum of 14% AR. Further hydroxylation in the C-4 position resulted in two additional identified metabolites, 4,8α-dihydroxy-avermectin B_{1a} and 8α-oxo-4-hydroxy-avermectin B_{1a}, each at < 10% AR. 4,8α-dihydroxy-avermectin B_{1a} is also present in an equilibrium mixture as the hemiacetal and the aldehyde forms. At least 25 other residues were also formed at low levels, each representing < 10%. The non-extracted residues and volatile fractions (CO_2), reached their maximum at the end of the incubation period (44 and 28% AR, respectively). About 6% AR was released by harsh extraction of non-extracted residues, mostly humic, fulvic and humin acids, with only minor amounts identified as avermectin B_{1a}.

Soil photolysis studies demonstrated a similar degradation pattern, except that under the influence of light, avermectin B_{1a} initially isomerises to the 8,9-Z isomer before degrading, mainly to 8α-hydroxy-avermectin B_{1a} and 8α-oxo-avermectin B_{1a} (up to 4.7% AR). The half-life in these studies were 21–22 days. Photolysis significantly increases the rate of degradation of avermectin B_{1a}, as the dark controls showed a half-life of 119 days.

[^{3}H-avermectin B_{1a}] was stable to hydrolysis at pH 4 to 7 under sterile conditions, minimal hydrolysis was observed at pH 9 (DT_{50} of 380 days at 20 °C), with one major transient non-polar degradate 2-epi-avermectin B_{1a} being observed. At 60 °C, this degradate reached a maximum of 25%AR by Day 11 and then degraded with a DT_{50} of 1.5 days. [23-^{14}C-avermectin B_{1a}] degraded in water under light to 8,9-Z avermectin B_{1a} and 8α-oxo-avermectin B_{1a} (half-lives < 6 days).

In summary, avermectin B_{1a} degrades relatively fast in soils, with half-life < 60 days, and 8α-hydroxy- and 8α-oxo- avermectin B_{1a} being the major products. Light accelerates the degradation in water and soil, and isomerises the compound to its 8,9-Z isomer. Aqueous hydrolysis is not a significant degradation route for avermectin B_{1a} at environmentally relevant pHs and temperatures.

Plant metabolism

The metabolism of [^{14}C]avermectin B_{1a} was investigated in citrus plants kept under an open wooden frame with a fibreglass roof and treated at 18 to 40 µg ai/kg on a whole fruit basis. The [^{14}C]avermectin B_{1a} solutions, prepared in a EC formulation blank, was brushed on each fruit (0.5 mL). After 12 weeks of treatment, residues ranged from 33.3% (grapefruit) to 49.8% (lemons) of the AR. On the day of application, at least 98.4%AR was removed from the surface with methanol, and by week 12, surface residues corresponded to up to 41%TRR in oranges. No residues were detected in the pulp without the peel/pulp interface for all fruits; when the interface was included, residues reached 12–13%TRR after 8 weeks. At day 0, at least 85% TRR of the methanol rinse and acetone peel extract was avermectin B_{1a}, the level then decreased rapidly after one week (to 4.4 to 17.4%TRR) and ≤ 7.7% TRR after 12 weeks, when polar residues accounted for at least 46% TRR. The 8,9-Z isomer of avermectin B_{1a} was present in all sample extracts (0.7–4.7%TRR). Non extracted residues ranged from 40–62% TRR at week 12, but were reduced to < 10%TRR after successive treatments (Bligh-Dyer procedure, soxhlet with methanol and acid or enzyme hydrolysis). Most of the non-extracted residues were polar degradates, with avermectin B_{1a} representing 9–12% TRR, and a fraction identified as a mixture of linoleic fatty esters.

The metabolism of avermectin B_{1a} was investigated in celery in three field experiments:

1) plants treated with ^{3}H-avermectin B_{1a} at 11.2 g ai/ha

2) at 112 g ai/ha, with immature plants harvested from 0 to 43 days after the 4th application and mature plants harvested at 0 to 22 days after the 10th application

3) plants treated with [^{14}C]avermectin B_{1a} at 16.8 g ai/ha, with immature plants harvested at 0 and 14 days after the 4th application and mature plants harvested at 0 to 7 days after the 10th application.

In general, residues in immature or mature leaves and stalks decreased significantly during the study period. For example, after the 4th application at 11.2 g ai/ha, residues in immature leaves were 2.74 mg/kg eq, decreasing to 11.5 μg/kg eq 43 days later. Acetone extracts accounted for over 95% TRR in immature leaves after the 4th application at all rates, with avermectin B_{1a} accounting for 65–75% of the extracted residue. After 14 days, leaf acetone extracts were about 80%TRR, with avermectin B_{1a} accounting for 16–26% of the residues and the 8,9-Z isomer for about 5%. In general, stalks and mature leaves showed similar profiles. The 8-hydroxy avermectin B_{1a} and at least ten other unidentified minor components were also detected in the samples. Residual solids from the leaf acetone extract were mostly extracted with methanol/water and hot DMSO, being mostly polar degradates of avermectin B_{1a}. About 15% of the acetone non-extracted residues in the leaves were incorporated into glucose.

The metabolism of [^{14}C]avermectin B_{1a} was investigated in <u>cotton</u> in four field experiments:

1) individual leaves treated with 100 μg of [^{14}C]avermectin B_{1a} and analysed 8 days after treatment (DAT)

2) cotton plants received two foliar applications at 20 g ai/ha (100 L/ha) and mature bolls harvested at 8 DAT

3) cotton plants were grown in buckets under normal field conditions and treated three times by foliar spray at 22.4 g ai/ha

4) 3× 224 g ai/ha (467 L/ha), and the bolls harvested at 20 DAT.

Over 99.7%AR in the leaves from Experiment 1 were extracted with methanol at day 0, decreasing to 19.3% at Day 8. Avermectin B_{1a} accounted for 99.2%AR at Day 0 and 1.7% AR after 8 days. Non-extracted residues reached 26.1%AR at Day 4. Leaves from Experiments 2 to 4 contained the highest residues (up to 400 μg/kg). Seeds contained up to 85 μg/kg and lint up to 750 μg/kg; this very high level was probably due to the last application in Experiment 4, when approximately 50% of the bolls were open. Avermectin B_{1a} represented most of residues in the leaves methanol rinse from the Experiment 3, accounting for 36% AR at day 1, which decreased to 1% AR by Day 8. The 8,9-Z isomer accounted for 7% AR at 0.25 day, decreasing to 0.1% AR at Day 8. From 26 to 35% TRR in the cotton seed (Experiments 2 to 4) was extracted with hexane, and characterized as triglycerides (linoleic and palmitic acid). Methanol extracts accounted for 50 to 65% TRR and non-extracted material for up to 25% TRR (Experiment 2).

One study was conducted to compare the profile of the residues of [^{14}C]avermectin B_{1a} *in vivo* (citrus, celery and cotton) and *in vitro* photolysis conditions. In this study, a [^{14}C]avermectin B_{1a} methanol solution was dried at room temperature and placed under a 275W Suntanner bulb. Most of the residues in the cotton leaf and citrus fruit surface were of a polar nature, with avermectin B1a accounting for 5–11% TRR after 7–8 days. In stalk and leaf extracts, avermectin B_{1a} accounted for 17 and 10% TRR at 7 DAT, respectively. The *in vitro* study also showed a major decline of avermectin B_{1a} residues with time (from 37% TRR after 19 hours of exposure to light to 7.3% TRR after 30 hours). Re-chromatography of the polar residues from the three treated crops and in the photolysis experiment showed four broad peaks of multiple-oxygenated, hydrated or dehydrated and de-methylated species, which retained little of the macrocyclic characteristics of avermectin B_{1a}.

Metabolism of avermectin B_{1a} was studied in <u>greenhouse-grown tomato</u> plants treated with [^{14}C]avermectin B_{1a} at 5× 26 g ai/ha (sub-study 1) and 3× 281 g ai/ha (sub-study 2). The major metabolite fractions in all of the analysed samples were avermectin B_{1a} and the 8,9-Z isomer of avermectin B_{1a}, in a ratio of approximately 9:1. TRR at 28 DAT in tomato and leaves from sub-study 1 were 0.127 and 6.4 mg/kg eq., respectively, with 51 and 34% as avermectin B_{1a} + its 8,9-Z isomer (9:1), respectively. In sub-study 2, the parent compound and its isomer accounted for 75 and 50% of the residues found in tomato and leaves, respectively. 8α-oxo-avermectin B_{1a}, 8α-hydroxy-avermectin B_{1a}, and 3"-O-desmethyl-avermectin B_{1a} were present at levels < 8% TRR in tomato and leaves samples. The non-extracted radioactivity did not exceed 2% TRR in tomato fruit and 7%TRR in the leaves.

In a field study conducted at 5× 26 g ai/ha or 5× 246 g ai/ha, total residues in tomatoes were 0.017 and 0.108 mg/kg, respectively, with avermectin B_{1a} + its 8,9-Z isomer accounting for 7.1 and 25%TRR, and the 8α-oxo- and 8α-hydroxy- metabolites for less than 3%TRR. In leaves, total residues were 0.71 and 7.8 mg/kg, respectively, with avermectin $B_{1a\ and}$ its isomer accounting for 2.2 and 6.4%TRR and the two metabolites up to 1.2%TRR.

Metabolism of avermectin B_{1a} was investigated in field-grown tomatoes under similar conditions as the greenhouse studies. The major metabolite fraction in all of the analysed samples was avermectin B_{1a} and its 8,9-Z isomer, accounting for about 70–80%TRR at 0 days and decreasing over time (2–6% TRR 28 days after the 5^{th} application). Other identified metabolites were 8α-oxo-avermectin B_{1a}, 8α-hydroxy-avermectin B_{1a}, and 3''-O-desmethyl-avermectin B_{1a}, present at levels < 7% TRR each in tomatoes and leaves at any sampling time in both experiments.

In a confined rotational crop study conducted in the field, sorghum, lettuce and carrots or turnips were planted in sandy, sandy loam and "muck" (high-organic drained swampland) soils. The soils were filled into large tubes and treated at 135 to 155% of the maximum label rate of 21.3 g ai/ha. The sandy soil received 3× 29.1 g ai/ha and sandy loam and muck soils 12× 33.6 g ai/ha. Sorghum and lettuce were planted in all soil types, turnip in the muck soil and carrot in the sand and sandy loam soils. The plant-back intervals (PBI) were 14, 123 and 365 days for the muck soil, 31, 120 and 365 days for the sandy soil and 29, 123 and 365 days for the sandy loam soil. The highest TRR was found in the lettuces samples from the muck soil (6.9 μg/kg eq.), from which extraction with acetone released only 4.4%TRR. Sorghum leaf-stem TRR ranged from 4 to 12 μg/kg eq. No identification of the residues were performed due to the low TRR levels in all samples.

In summary, the plant metabolism studies conducted in citrus, cotton, celery and tomatoes showed that the residues of avermectin B_{1a} are not significantly translocated into the plants, remaining on the surface, where it is photodegraded to its 8,9-Z isomer. The major proportion of the residues remains parent avermectin B_{1a}. The metabolism pathway include the re-arrangement to the 8,9-Z isomer, hydroxylation to 8α-hydroxy-avermectin $B_{1a,}$ further oxidation to 8α-oxo-avermectin B_{1a}, demethylation to 3"-O-desmethyl-avermectin B_{1a}, and oxidation of the 8α-hydroxy- to form the 4"-oxo-avermectin B_{1a} and 4"-,8α-di-oxo-avermectin $B_{1a.}$ The lack of uptake of radioactive material in succeeding crops indicates the non-systemic behaviour of avermectin B_{1a} and its soil degradates.

Animal metabolism

The metabolism of ^{3}H- and ^{14}C-radiolabelled abamectin B_{1a} in rats was evaluated by the WHO group. In summary, the metabolism of avermectin B_{1a} in the rat proceeded predominantly via demethylation, hydroxylation, cleavage of the oleandrosyl ring, and oxidation reactions. Unchanged avermectin B_{1a} and the metabolites 3"-O-desmethyl, 24-hydroxymethyl, 27-hydroxymethyl, 3"-O-desmethyl-24-hydroxymethyl and 3"-O-desmethyl-27-hydroxymethyl abamectin B1a represented the majority of the faecal radioactivity.

One goat metabolism study was submitted to the meeting. Six lactating goats were dosed daily for ten consecutive days with ^{3}H-avermectin B_{1a} at 0.00125 (D1), 0.0125 (D2) and 0.25 ppm (D3) (two animals per dose) and sacrificed after 24 hours. Urine and faeces were collected daily and goats were milked twice daily. The majority of the radioactivity was found in the faeces (79 to 98% AR). Milk residues plateaued by day 4–6 and were dose dependent (0.34 and 2.6 μg/kg eq. at D2 and D3, respectively). In tissues, highest residues were found in liver (mean of 0.4, 2.8 and 57.2 μg/kg eq. at D1, D2 and D3, respectively), fat (< 0.2, 1.8 and 40.9 μg/kg eq.) and kidney (0.3 to 13.8 μg/kg eq.). In muscle, residues were < 0.2, 0.32 and 5.2 μg/kg eq. Avermectin B_{1a} was the major residue in all tissues, comprising from 41–95%TRR in liver, 40–97%TRR in kidney, 73 to 96%TRR in muscle, 86–99% in fat, and 70–95%TRR in milk. Metabolite 24-hydroxymethyl-avermectin B_{1a} was a major residue in liver of the D1 goats (45.5%TRR) and was present at 2–11% TRR in milk from D3. A second metabolite, 3''-desmethyl-avermectin B_{1a}, was only isolated from Goat 5 liver (≤ 5% TRR). Fat tissue was shown to contain 24-hydroxymethyl avermectin B_{1a} in a conjugated form.

Based on the structures identified, the metabolism of avermectin B_{1a} in the goat proceeds via hydroxylation of the methyl group to 24-hydroxymethyl-avermectin B_{1a} and to a lesser extent demethylation at the 3" position. Avermectin B_{1a} is the major residues in all animal matrices. The metabolic pathway in rats showed a similar profile.

Methods of residue analysis

Abamectin residues in plant materials are analysed by two methods, one by HPLC with fluorescent detector (HPLC-FL; Exc.: 365 nm, Em.: 470 nm) and the other, used in more recent supervised trials, by LC-MS/MS. Transition ions for avermectin B1a and its isomer ($[M+Na]^+$) were m/z = 895.5 → 751.5 for quantification and m/z = 895.5 → 449.2 for confirmation.

In the HPLC-FL method, residues are extracted with acetonitrile or methanol and partitioned with hexane, the organic extract is cleaned-up in an aminopropyl solid phase extraction (SPE), and residues eluted with ethyl acetate/methanol. Fluorescent derivatives are formed by reaction with a mixture of triethylamine, trifluoroacetic anhydride and 1-methylimidazole and determined by HPLC-FL. Avermectin B_{1a} and its 8,9-Z isomer results in a single peak, and is determined as the sum of both compounds. It is the same for avermectin B_{1b} and its 8,9-Z isomer. The LOQ for the individual analytes were 0.002 or 0.005 mg/kg for most studies.

The LC-MS/MS methods quantify individually avermectin B_{1a}, avermectin B_{1b} and their 8,9-Z isomers. Residues are extracted with acetonitrile or methanol, partitioned into toluene and cleaned-up using aminopropyl, amino or C8 SPE (LOQ of 0.002 to 0.01 mg/kg), or only extracted with dichloromethane before the analysis (LOQ of 0.02 mg/kg). The method that included the clean-up step was also validated for avermectin B_{1a}, and its 8,9-Z isomer in animal matrices (LOQ of 0.002 mg/kg).

An LC-MS/MS multi-residue QuEChERS method for the determination of residues of avermectin $B_{1a,}$ avermectin B_{1b} and avermectin B_{1a} 8,9-Z isomer in lettuce, sunflower seeds, dried broad beans, wheat grain, oranges and dried hops was validated at the LOQ of 0.002 mg/kg.

Stability of residues during storage

Residues of avermectin B_{1a} in <u>citrus peel</u> samples fortified at levels of 0.005 or 0.025 mg/kg were stable for at least at 52 months when stored at ≤ –10 ºC. Residues of avermectin B_{1a} (0.01 or 0.05 mg/kg), avermectin B_{1b} (0.004 mg/kg) and avermectin B_{1a} 8,9-Z isomer (0.009 mg/kg) were shown to be stable in tomato samples for at least 15 months, in celery and strawberry samples for at least 24 months and in pear samples for at least 35 months. Residues of the three analytes at 0.04 mg/kg were shown to be stable for at least 24 months at ≤ –18 ºC when present in orange peel, green beans, sunflower seeds and potatoes. Residues of avermectin B_{1a} and its 8,9-Z isomer (0.02 mg/kg) in grapes and processed commodities were shown to be stable for at least one year under frozen conditions, with the exception of raisins, for which only 28% of avermectin B_{1a} residues remained after 12.5 years.

In summary, avermectin B_{1a} and its 8,9-Z isomer and avermectin B_{1b} were shown to be stable for at least 12 months in a variety of crop samples stored under frozen conditions, except raisins. The storage period of the samples in the residue trials guarantee the stability of the residues, unless it is specified otherwise.

Residue definition

Plant metabolism field studies conducted with ^{14}C and/or ^{3}H-avermectin B_{1a} in citrus, cotton, celery and tomatoes (also glasshouse studies) have shown that the major residue is avermectin B_{1a} (over 20% TRR), which remains on the surface of the crop and isomerizes to the 8,9-Z isomer. When present, the hydroxyl, oxo and desmethyl metabolites each accounted for < 10%TRR. Significant residues in rotational crops are not expected.

Abamectin is a mixture of ≥ 80% avermectin B_{1a} and ≤ 20% avermectin B_{1b}. In most residue trials, avermectin B_{1b} was found at levels < LOQ, and when present, the levels are significantly lower than avermectin B_{1a}. Hence, avermectin B_{1a} is an adequate marker for the use of abamectin products.

Although the HPLC-FL method used to analyse abamectin residues measure avermectin B_{1a} plus its 8,9-Z isomer together, the isomer is not expected to be a significant part of the residue (one study in tomato estimated a 9:1 ratio of both compounds) and was never detected in trials when the LC-MS/MS method was used. The toxicity of 8,9-*Z* isomer of abamectin B_{1a} is of no greater toxicity than the parent abamectin B_{1a}.

The Meeting agreed for the following residue definition for abamectin in plant commodities for enforcement and dietary risk assessment:

Avermectin B_{1a}

The metabolism of avermectin B_{1a} in lactating goats showed the parent compound as the main residue in all matrices (at least 40%TRR), with only one major metabolite (24-hydroxymethyl-avermectin B_{1a}), which accounted for 45.5%TRR in livers of the low dosed goats (0.00125 ppm) and up to 11% TRR in milk. The toxicity of 24-hydroxymethyl-avermectin B_{1a} is of no greater toxicity than the parent abamectin B_{1a}.

The Meeting agreed for the following residue definition for abamectin in animal commodities for enforcement and dietary risk assessment: Avermectin B_{1a}

Residues of avermectin B_{1a} are five times higher in fat than in muscle and the log K_{OW} is 4.4, which indicates fat solubility.

The residues are fat soluble.

Residues resulting from supervised residue trials on crops

As no trials were submitted on summer squash and watermelon, the Meeting withdraws its previous recommendations for these commodities

Citrus fruits

In the USA, GAP for abamectin in citrus is up to three applications at a maximum rate of 26 g ai/ha (max. of 53 g ai/ha per season), and 7 days PHI. Twenty one trials were conducted in the USA in citrus (grapefruit, orange, tangelo and lemon).

In nine trials conducted in oranges at GAP, abamectin residues at 7 days PHI were < 0.005 (6), 0.008, 0.010 and 0.014 mg/kg. The highest residue in a replicate samples was 0.015 mg/kg.

In two trials conducted at GAP in grapefruit, one in tangelos and one in lemons, residues were < 0.005 (4).

The median residues found in the different crops is the same, which allows the consideration of a group estimation. However, the residue populations are not similar, with residues in oranges being significantly higher than in the other crops.

Based on the residues in oranges, the Meeting estimated a maximum residue level of 0.02 mg/kg, a STMR of 0.005 mg/kg and a HR of 0.015 mg/kg for abamectin in citrus.

This estimation replaces the previous recommendation for abamectin in citrus.

Pome fruit

GAP for abamectin in pome fruit in Italy is up to 2× 22 g ai/ha and 28 days PHI. Various trials were conducted in Europe according to this GAP in apples and pears from 1986 to 2012.

In 26 trials conducted on apples in Europe according to Italian GAP, residues of abamectin were < 0.002 (20), 0.003 (2), 0.004 (2), 0.007 (2) mg/kg. The highest residue in a replicate samples was 0.010 mg/kg.

Two trials conducted in pears at GAP gave abamectin residues of < 0.002 mg/kg (2). Five trials using three applications of the GAP rate also found no residues.

Based on the residue data in apples, the Meeting estimated a maximum residue level of 0.01 mg/kg, a STMR of 0.002 mg/kg and a HR of 0.01 mg/kg for abamectin in pome fruit.

The Meeting withdraws its previous recommendations for apple and pears.

Stone fruit

GAP for abamectin in stone fruit in the USA is 2× 26 g ai/ha and 21 days PHI. Fifteen trials were conducted in cherry in USA according to this GAP, giving abamectin residues of 0.003 (2), 0.004, 0.005, 0.006, 0.007, 0.008, 0.009 (2), 0.010, 0.011, 0.015, 0.016, 0.024, 0.047 mg/kg. The highest residue in a replicate samples was 0.058 mg/kg.

Thirteen trials were conducted in peaches in the USA according to GAP, giving abamectin residues of < 0.002, 0.002 (6), 0.003, 0.004 (2), 0.005, 0.006 (2), 0.008 and 0.024 mg/kg.

Fifteen trials were conducted in plums in the USA according to GAP, giving abamectin residues of < 0.002 (7), 0.002, 0.003 and 0.004 (4) mg/kg. The highest residue in a replicate samples was 0.006 mg/kg

In Italy, GAP for abamectin in peaches is 2× 22 g ai/ha and 14 days PHI. In five trials conducted in France, Italy and Spain according to this GAP, abamectin residues in the whole fruit were < 0.002 (3), 0.004 and 0.006 mg/kg. Residues in the pulp were < 0.002 (3), 0.004 and 0.007 mg/kg

The residue populations in cherries, peaches and plums from the USA gave the highest residues and will be considered for the sub-group estimations.

The Meeting estimated a maximum residue level of 0.07 mg/kg, a STMR of 0.009 mg/kg, and a HR of 0.058 mg/kg for abamectin in cherries.

The Meeting estimated a maximum residue level of 0.03 mg/kg, a STMR of 0.002 mg/kg and a HR of 0.024 mg/kg for abamectin in peaches.

The Meeting estimated a maximum residue level of 0.005 mg/kg, a STMR of 0.004 mg/kg and a HR of 0.006 mg/kg for abamectin in plums.

Raspberry

GAP for abamectin in raspberries and blackberries in Italy is one application at 22 g ai/ha and 7 days PHI. In four trials conducted in Italy at GAP, abamectin residues were < 0.02 (2), 0.02 and 0.03 mg/kg

The Meeting estimated a maximum residue level of 0.05 mg/kg, a STMR of 0.02 mg/kg and a HR of 0.03 mg/kg for abamectin in raspberry, red, black.

The Meeting agreed to extend this estimation to blackberries.

Strawberry

In Denmark, GAP for abamectin in strawberries is greenhouse applications at 3× 22 g ai/ha and 3 days PHI. In eight greenhouse trials conducted in France and Spain according to this GAP, abamectin residues were 0.004, 0.006, 0.014, 0.020, 0.034, 0.042, 0.045 and 0.071 mg/kg. The highest residue in duplicate samples was 0.073 mg/kg.

In the USA, GAP is 4× 21 g ai/ha and 3 days PHI. In five protected trials conducted at GAP, residues were 0.005 (2), 0.006, 0.007 and 0.008 mg/kg. In seventeen field trials, residues were < 0.005 (5), 0.006 (4), 0.009 (2), 0.010 (2), 0.016, 0.020, 0.026, and 0.028 mg/kg.

Based on the protected trials conducted in Europe that gave the highest residues, the Meeting estimated a maximum residue level of 0.15 mg/kg, a STMR of 0.027 mg/kg and a HR of 0.071 mg/kg for abamectin in strawberries.

This estimation replaces the previous recommendation for abamectin in strawberries.

Grapes

GAP for abamectin in grapes in the USA is 2× 21 g ai/ha and 28 days PHI. In nineteen trials conducted in the USA at GAP, residues of abamectin were < 0.002 (10), 0.002 (4), 0.004 (3), and 0.006 (2) mg/kg. The highest residue in a replicate samples was 0.010 mg/kg

The Meeting estimated a maximum residue level of 0.01 mg/kg, a STMR of 0.002 mg/kg and a HR of 0.010 mg/kg for abamectin in grapes.

Avocado

In the USA, GAP for abamectin in avocados is 2× 26 g ai/ha and 14 days PHI. In five trials conducted at GAP in the country, residues were < 0.002, 0.003, 0.004 (2), and 0.007 mg/kg. The highest residue in a replicate samples was 0.009 mg/kg

The Meeting estimated a maximum residue level of 0.015 mg/kg, a STMR of 0.004 mg/kg and a HR of 0.009 mg/kg for abamectin in avocados.

Mango

In Brazil, GAP for abamectin in mangoes is 4× 14 g ai/ha and 7 days PHI. In five trials conducted in the country at GAP, abamectin residues were < 0.002 (3), < 0.004 and 0.004 mg/kg.

The Meeting estimated a maximum residue level of 0.01 mg/kg, a STMR of 0.002 and HR of 0.004 mg/kg for abamectin in mangoes.

Papaya

In Brazil, GAP for abamectin in papaya is 3× 22 g ai/ha and 14 days PHI. In eight trials conducted in the country at GAP, abamectin residues in papaya fruit were < 0.002, 0.002, 0.003 (2), 0.004, 0.005 (2) and 0.008 mg/kg. Residues in the pulp were < 0.002 (6) mg/kg. Six trials conducted at double rate did not show any residues in the pulp (< 0.002 mg/kg), confirming a no residue situation in the pulp when the fruit is treated at GAP.

The Meeting estimated a maximum residue level of 0.015 mg/kg, a STMR and HR of 0 mg/kg for abamectin in papaya.

Onion and shallot

GAP for onions, bulbs (include shallots) in the USA is 2× 21 g ai/ha and 30 days PHI. In eight trials conducted in the country using 3–4 applications at the GAP rate gave residues of < 0.002 (7) and 0.002 mg/kg. The highest residue in a replicate samples was 0.003 mg/kg.

Meeting estimated a maximum residue level of 0.005 mg/kg, a STMR of 0.002 and HR of 0.003 mg/kg for abamectin in onion bulbs. This estimation was extrapolated to shallots and garlic.

Leek

GAP for abamectin in leek in Belgium is 3× 9 g ai/ha and 7 days PHI. Twelve trials conducted in France and the Netherlands within this GAP gave abamectin residues of < 0.002 (10) and 0.002 (2) mg/kg. The highest residue in a replicate samples was 0.003 mg/kg.

The Meeting estimated a maximum residue level of 0.005mg/kg, a STMR of 0.002 mg/kg and HR of 0.003 mg/kg for abamectin in leek.

Cucumber/gherkin

In Denmark, GAP for abamectin in cucumbers and gherkins is four greenhouse applications at 22 g ai/ha with a 3 day PHI. Twenty-nine protected trials were conducted in Europe from 1989 to 2013. In twenty five trials (3-5 applications) conducted according to the Denmark GAP, abamectin residues were < 0.002 (6), < 0.005 (5), 0.002 (6), 0.003, 0.004 (2), 0.005, 0.006, 0.007 (2) and 0.025 mg/kg. The highest residue in a replicate samples was 0.029 mg/kg.

The Meeting estimated a maximum residue level of 0.03 mg/kg, a STMR of 0.002 and HR of 0.029 mg/kg for abamectin in cucumbers. This estimation was extrapolated to gherkins.

Melon

In Denmark, GAP for abamectin in melons is three greenhouse applications at 22 g ai/ha and 3 days PHI. Twelve greenhouse trials (3-4 applications) were conducted in Europe from 2000 to 2008 according to this GAP, giving abamectin residues the whole fruit of < 0.002 (6), 0.002 (3), 0.003 (2) and 0.005 mg/kg. Residues in the pulp were < 0.002 (10) mg/kg.

The Meeting estimated a maximum residue level of 0.01 mg/kg, a STMR and HR of 0.002 mg/kg for abamectin in melons, except watermelon.

This estimation replaces the previous recommendation for abamectin in melons, except watermelons.

Pepper

In Denmark, GAP for abamectin in sweet or bell peppers is five greenhouse applications at 22 g ai/ha and 3 days PHI. In eighteen greenhouse trials conducted in Europe within this GAP, abamectin residues were < 0.005 (3), 0.002 (2), 0.004, 0.005, 0.006, 0.008, 0.010, 0.012, 0.015, 0.018, 0.019, 0.02, 0.025, 0.027 and 0.051 mg/kg.

In the USA, GAP for fruiting vegetables, except cucurbits, is 2× 21 g ai/ha and 7 days PHI. Four trials were conducted in chilli pepper using six applications, giving residues < 0.005 mg/kg (4).

The Meeting estimated a maximum residue level of 0.09 mg/kg, a STMR of 0.007 mg/kg and HR of 0.051 mg/kg for abamectin in peppers, sweet.

This estimation replaces the previous recommendation for abamectin in peppers, sweet.

The Meeting estimated a maximum residue level of 0.005* mg/kg, a STMR and a HR of 0.005 mg/kg for abamectin in peppers, chilli.

This estimation replaces the previous recommendation for abamectin in chilli pepper.

The Meeting withdraws its previous recommendation for pepper, chilli, dried.

Tomato and eggplant

GAP for abamectin in tomatoes in Denmark is five greenhouse applications at 22 g ai/ha and in Greece, GAP for tomatoes and eggplants is 4× 22 g ai/ha. In both countries, the PHI is 3 days. Metabolism studies have shown that abamectin degrades rapidly and the Meeting agreed that only the last applications will impact the final residues and decided to use the trials with a lower number of applications for the estimations.

In twenty six greenhouse tomato trials using two to five applications at the GAP rate gave residues of < 0.002 (5), 0.002, 0.003, 0.004 (6), 0.005, 0.006 (2), 0.007 (2), 0.010, 0.011, 0.012, 0.014, 0.24, 0.25 and 0.027 (2) mg/kg.

Nine tomato field trials were conducted in France, Italy and Spain using 3–4 applications of the GAP rate, matching the Greek GAP gave residues of < 0.002 (6) and 0.002 (3) mg/kg.

Based on the greenhouse trials, which gave the highest residues, the Meeting estimated a maximum residue level of 0.05 mg/kg, a STMR of 0.004 mg/kg and HR of 0.027 mg/kg for abamectin in tomato.

This estimation replaces the previous recommendation for abamectin in tomatoes.

In two field trials conducted in eggplants in France using six applications, no abamectin residues were detected at 3 days PHI (< 0.010 mg/kg).

As three trials is not enough for the estimations, the Meeting agreed to extend the estimations for tomatoes to eggplants.

Lettuce

Abamectin can be used in lettuce in Greece at 4× 9 g ai/ha and 14 days and in Italy (includes cos lettuce) at 3× 18 g ai/ha and 7 days PHI.

Nine field trials were conducted in Italy and France according to Italian GAP, giving abamectin residues at 7 days PHI of < 0.002, 0.003 (2) and 0.005 mg/kg in head lettuce, 0.004 and 0.007 mg/kg in leafy lettuce and < 0.002, 0.003, 0.006 and 0.008 mg/kg in cos lettuce.

In protected trials conducted in Europe according to GAP in Greece, residues at 14 days PHI in head lettuce were (n=8) 0.007, 0.011, 0.019, 0.020, 0.035, 0.045, 0.047 and 0.097 mg/kg. Residues from protected trials conducted according to GAP with unidentified lettuce type ranged from 0.003 to 0.012 mg/kg.

Protected trials conducted in head lettuce according to GAP in Greece gave the highest residues. The Meeting estimated a maximum residue level of 0.15 mg/kg, a STMR of 0.0275mg/kg and a HR of 0.097 mg/kg for abamectin in head lettuce.

The Meeting agreed that there are not enough trials to estimate a maximum residue level for abamectin in leafy lettuce and cos lettuce.

The Meeting withdraws its previous recommendation on leafy lettuce.

Corn salad (lambs lettuce)

Abamectin can be used in lambs lettuce in Italy at 3× 18 g ai/ha and 7 days PHI. Two trials were conducted in lambs lettuce in France, but they were not according to GAP.

The Meeting agreed not to estimate a maximum residue level for abamectin in lambs lettuce

Spinach

In the USA, GAP for abamectin in spinach is 2× 21 g ai/ha and 7 days PHI. Six declining trials using six application (7 days interval) and metabolism studies showed a rapid declining of the residues, indicating that the contribution of the early applications does not impact the final residue. In eleven trials conducted with 3–6 applications abamectin residues at 7 days PHI were < 0.002 (2), 0.016, 0.020, 0.021, 0.024, 0.028, 0.042, 0.044, 0.048 and 0.085 mg/kg. The highest residue in a replicate samples was 0.091 mg/kg.

The Meeting agreed to recommend a maximum residue level of 0.15 mg/kg, a STMR of 0.024 mg/kg and a HR of 0.091 mg/kg for abamectin in spinach.

The IESTI from the consumption of spinach represented 140% of the ARfD for abamectin (0.003 mg/kg bw). No alternative GAP was available to the Meeting.

Bean, green with pods

The GAP for abamectin in green beans in Spain is 3× 18 g ai/ha and 3 days PHI. In thirteen greenhouse trials conducted in Italy and Spain according to this GAP, residues in green bean with pods were < 0.002 (4), 0.003, 0.004, 0.007, 0.012, 0.014, 0.016, 0.017, 0.023, and 0.049 mg/kg

The meeting estimated a maximum residue level of 0.08 mg/kg, a STMR of 0.012 mg/kg and a HR of 0.049 mg/kg for abamectin in beans, except broad beans and soya beans (green pods and immature seeds).

Beans, dry

GAP for abamectin in beans, dry, in the USA is 2× 21 g ai/ha and 7 days PHI. In seven trials conducted in the USA using three applications, residues were < 0.002 (6) and 0.003 mg/kg.

As it is unlikely that the first application would impact the final residue, the Meeting agreed to use these trials for estimating a maximum residue level of 0.005 mg/kg and a STMR of 0.002 mg/kg for abamectin in beans, dry.

Celeriac

GAP for abamectin in celeriac in the USA is 2× 21 g ai/ha and 7 days PHI. Two trials were conducted in the country using three applications gave no residues in the root (< 0.002 mg/kg)

The Meeting agreed that two trials are not sufficient to estimate a maximum residue level for abamectin in celeriac.

Potato

In the USA, the GAP for abamectin in tuberous and corm vegetables, which include potatoes, sweet potatoes and yams, is 2× 21 g ai/ha and 14 days PHI. In thirteen potato trials conducted in the country from 1992 to 1998 using from 3-6 applicatons at GAP, no abamectin residues were detected in potato tubers (< 0.005 mg/kg). Trials conducted at 6 × 112 g ai/ha gave the same result.

The Meeting estimated a maximum residue level of 0.005* mg/kg, a STMR and a HR of 0 mg/kg for abamectin in potato. The Meeting agreed to extrapolate this recommendation to sweet potato and yams.

This estimation replaces the previous recommendation for abamectin in potatoes.

Radish

GAP for abamectin in radishes in Belgium is 2× 10 g ai/ha and 14 days PHI. In one protected trial conducted in the Netherlands in 1999 within this GAP, abamectin residues in the root were < 0.002 mg/kg.

The Meeting agreed that one trial is not sufficient to estimate a maximum residue level for abamectin in radishes.

Celery

GAP for abamectin in celery in Greece is 4× 9 g ai/ha and 14 days PHI. In seven trials conducted using three applications, samples were collected at 10 DAT.

In the USA, GAP is 2× 21 g ai/ha and 7 days PHI. Six trials conducted in the country using three applications gave residues of 0.003, 0.005 (2), 0.006 0.01 and 0.016 mg/kg

As it is unlikely that the first application would impact significantly the final residue, the Meeting agreed to use these trials to estimate a maximum residue level of 0.03 mg/kg, a STMR of 0.005 mg/kg and a HR of 0.016 for abamectin in celery.

Rice

In China, GAP for abamectin in rice is 2× 14 g ai/ha and 21 days PHI. In six trials conducted in the country according to GAP, abamectin residues in rice husked were < 0.001 mg/kg (6). Six trials conducted at 2× 20 g ai/ha rate gave residues of < 0.001 (4), 0.001 and 0.002 mg/kg. Applying the proportionally principle to this dataset, residues according to GAP are < 0.001 (5) and 0.0015 mg/kg.

Residues on the 12 trials combined are < 0.001 mg/kg (11) and 0.0015 mg/kg.

The Meeting estimated a maximum residue level of 0.002 mg/kg and a STMR of 0.001 mg/kg for abamectin in rice, husked.

Tree nuts

In the USA, GAP for abamectin in tree nuts is 2× 26 g ai/ha and 21 days PHI. In three trials conducted in almonds according to GAP, residues were <0.005 mg/kg. In another 29trials conducted in almond, pecan and walnut using 3 applications of 28 or 56 g ai/ha, residues at 3 to 14 DAT gave the same result.

As trials conducted at higher GAP or shorter DAT do not give rise to residues in nut meat, the Meeting estimated a maximum residue level of 0.005* mg/kg, a STMR and a HR of 0 mg/kg for abamectin in tree nuts.

The Meeting withdraws its previous recommendation for almonds and walnuts.

Cotton

GAP for abamectin in cotton in Spain is 3× 18 g ai/ha and 3 days PHI. Five trials were conducted in Greece and Spain using two applications, giving abamectin residues at 3 days PHI of < 0.002 mg/kg (5).

In the USA, GAP is 2× 21 g ai/ha and 20 days PHI. In eleven trials conducted in the country according to GAP, residues were < 0.002 (9), 0.005 and 0.01 mg/kg.

The Meeting estimated a maximum residue level of 0.015 mg/kg and a STMR of 0.002 mg/kg for abamectin in cotton seed.

This estimation replaces the previous recommendation for abamectin in cotton.

Peanut

Abamectin is registered in Argentina to be used in peanuts at 1× 2 g ai/ha and 30 days PHI. Four trials were conducted in Brazil using 3× 14 g ai/ha, giving residues < 0.005 mg/kg (4).

Based on the Brazilian trials conducted at high rate and metabolism studies that showed no translocation of abamectin residues in the plant, the Meeting estimated a maximum residue level of 0.005* mg/kg, and a STMR of 0 mg/kg for abamectin in peanuts.

Coffee

Critical GAP for abamectin in coffee in Brazil is one application at 27 g ai/ha and 14 days PHI. Five trials were conducted in the country using 7–9 g ai/ha, giving residues < 0.002 mg/kg (5).

As no trials were conducted according to GAP, the Meeting could not estimate a maximum residue level for abamectin in coffee.

Hops

Abamectin is registered in hops in Slovenia and the USA to be used at 2× 21–22 g ai/ha and 28 days PHI. In seven trials conducted in Germany according to this GAP, abamectin residues in dried cones were < 0.005 (2), 0.010, 0.012 0.02, 0.021 and 0.028 mg/kg. In four trials conducted in the USA at GAP, residues were 0.012, 0.020, 0.056 and 0.061 mg/kg.

Trials conducted in the USA gave the highest residues, and the Meeting estimated a maximum residue level of 0.15 mg/kg and a STMR of 0.038 mg/kg for abamectin in hops, dry.

This estimation replaces the previous recommendation for abamectin in hops, dry.

Feed commodities

Rice husks

In six trials conducted with abamectin in rice in China according to GAP (2× 14 g ai/ha), abamectin residues in rice husks (hulls) at 21 days PHI were < 0.001 (5) mg/kg and 0.006 mg/kg.

The Meeting estimated a median residue of 0.001 mg/kg for abamectin in rice hulls.

Residues in paddy rice plant (including grain with husks) in trials according to GAP were < 0.001 mg/kg (6). Trials conducted at 20 g ai/ha gave the same results.

As no residues were found in rice plant, the Meeting estimated a maximum residue level of 0.001 mg/kg, a median and highest residue of 0.001 mg/kg for abamectin in rice straw.

Green beans

In four European trials conducted in green beans according to GAP in Spain (3× 18 g ai/ha, 3 days PHI), abamectin residues in the vines were 0.329, 0.349, 0.354, and 0.581 mg/kg.

The Meeting estimated a median residue of 0.352 mg/kg and highest residue of 0.581 mg/kg for abamectin in green bean vines.

Almond hulls

In six trials conducted in almonds in the USA at the GAP, residues in the hulls at 21 days PHI were < 0.002, 0.012, 0.035, 0.037, 0.102 and 0.11 mg/kg.

The Meeting estimated a maximum residue level of 0.2 mg/kg and a median residue of 0.036 mg/kg for abamectin in almond hulls.

Cotton hulls

As no trials were conducted in cotton according to GAP that analysed the hulls, the Meeting could not make any estimation for abamectin in cotton hulls.

Fate of residues in processing

Three processing studies were conducted in grapes, with abamectin residues in grapes of 0.012, 0.007 and 0.048 mg/kg. Although the stability study on grape processed commodities have shown that abamectin residues were not stable after 12 months in raisins, in the processed study the samples were analysed within a month after being generated, and the results are evaluated. Eleven studies were conducted in cotton, all in the context of the residue trials described before. The estimated processing factors with the respective recommendations of STMR-P, based on the recommended maximum residue level, are shown in the Table.

RAC	Processed product	PF (median or best estimate)	STMR-P, mg/kg	HR-P, mg/kg	MRL, mg/kg
Grapes	Dried grape	1, 2.8, 3.1	0.0056	0.028	0.03
MRL = 0.01 mg/kg	Grape juice	< 0.25, < 0.57, 1.4	0.0028		0.015
STMR = 0.002 mg/kg	Wet pomace	4.75	0.009		
HR = 0.01 mg/kg	dry pomace	15.8	0.0316		
Plums	Prune	0.8 [a]			
Cotton	Meal	< 0.028, < 0.067	0.000		
STMR = 0.002 mg/kg	Refined oil	< 0.028, < 0.67	0.000		

[a] Recommendation for Plums includes prunes

Residues in animal commodities

A feeding study was conducted in dairy cows (n=3) with abamectin dosed at 0.01, 0.03 and 0.10 ppm levels for 28–30 days. Avermectin B1a residues were determined by HPLC-FL, with an LOQ of 0.001 mg/kg in tissues and 0.0005 mg/kg in milk. Residues in muscle at any feeding level were < 0.01 mg/kg (traces at 0.002 mg/kg at all levels), and in kidney (traces at 0.004–0.005 mg/kg at 0.10 ppm). At this highest dose, maximum residues were 0.014 mg/kg (mean of 0.012 mg/kg) in fat and 0.020 mg/kg in liver (mean of 0.019 mg/kg). In milk, residues were only detected after 2 days dosing at 0.10 ppm (0.001 mg/kg), reaching a maximum of 0.004 mg/kg at day 14, and decreasing to the initial levels at the end of the dosing period. Overall mean was < 0.0005 mg/kg.

Farm animal dietary burden

The Meeting estimated the dietary burden of abamectin in farm animals on the basis of the OECD Animal Feed data published in the 2009 FAO Manual, the STMR, STMR-Ps or highest residue levels estimated at the present JMPR Meetings.

The commodities used to estimate the dietary burden were rice, husked, rice straw, rice hulls, grape pomace dried, bean vines, almond husk, bean dry, and cotton meal. As abamectin is not registered in beans and grapes in Australia, and is unlikely that bean vines and grape pomace would be animal feed in the country, as they are not imported commodities, they were excluded in the calculation for the Australian diet.

Livestock dietary burden for abamectin, ppm of dry matter (DM) diet

	US-Canada		EU		Australia		Japan	
Commodity	Max	Mean	Max	Mean	Max	Mean	Max	Mean
Beef cattle	0.0003	0.0003	0.0007	0.0007	0.004	0.004	0.0006	0.0006
Dairy cattle	0.004	0.004	0.333 [a, b]	0.202 [c, d]	0.004	0.004	0.0003	0.0003
Poultry—broiler	0.0007	0.0007	0.0006	0.0006	0.002 [e]	0.002		
Poultry—layer	0.0007	0.0007	0.0007	0.0006	0.002	0.002 [f]		

[a] Highest maximum beef or dairy cattle dietary burden suitable for maximum residue level estimated for mammalian tissues

[b] Highest maximum dairy cattle dietary burden suitable for maximum residue level estimated for mammalian milk

[c] Highest mean beef or dairy cattle dietary burden suitable for STMR estimated for mammalian tissues.

[d] Highest mean dairy cattle dietary burden suitable for STMR estimated for milk.

[e] Highest maximum poultry dietary burden suitable for maximum residue level estimated for poultry tissues and eggs.

[f] Highest mean poultry dietary burden suitable for STMR estimated for poultry tissues and eggs.

Animal commodity maximum residue level

The calculated maximum cattle dietary burden suitable for the estimation of maximum residue level of tissues and milk is 0.333 ppm. For the estimation of STMRs, the cattle dietary burden was 0.202 ppm.

The feeding level in lactating cows was conducted in a much lower dose (up to 0.10 ppm) than the estimated dietary burden. The Meeting agreed not to make any estimation for abamectin in mammalian commodities.

The Meeting withdraws its previous recommendations for cattle fat, cattle kidney, cattle liver, cattle meat, cattle milk, goat meat, goat milk and goat, edible offal.

Currently, the existing Codex MRLs for abamectin as a veterinary drug only intended to be used in beef cattle are 0.1 mg/kg in cattle liver and cattle fat and 0.05 mg/kg in cattle kidney.

The calculated maximum poultry dietary burden suitable for maximum residue level estimated for poultry tissues and eggs was 0.002 ppm. No feeding study on poultry was submitted to the Meeting.

RECOMMENDATIONS

On the basis of the data from supervised trials the Meeting concluded that the residue levels listed in Annex 1 are suitable for establishing maximum residue limits and for IEDI and IESTI assessment.

Residue definition for plant commodities for enforcement and dietary risk assessment: *Avermectin* B_{1a}

Residue definition for animal commodities for enforcement and dietary risk assessment: *Avermectin* B_{1a}

The residues are fat soluble.

CCN	Commodity	Recommended Maximum residue level (mg/kg)		STMR or STMR-P mg/kg	HR or HR-P mg/kg
		New	Previous		
AN 0660	Almond hulls	0.2	0.1	0.036	
TN 0660	Almonds	W	0.01*		
FP 0226	Apple	W	0.01*		
FI 0326	Avocado	0.015		0.004	0.009
VP0061	Beans, except broad bean and soya bean (immature beans with pods)	0.08		0.007	0.049
VD 0771	Beans (dry)	0.005		0.002	
FB 0264	Blackberries	0.005		0.002	0.003
MF 0812	Cattle fat	W	0.1		
MO 1280	Cattle kidney	W	0.05		
MO 1281	Cattle liver	W	0.1		
MM 0812	Cattle meat	W	0.01*		
ML 0812	Cattle milk	W	0.005		
VX 0578	Celery	0.03		0.005	0.016
FS 0013	Cherries	0.07		0.009	0.058
FC 0001	Citrus fruits	0.2	0.01*	0.005	0.015
SO 0691	Cotton seed	0.015	0.01*	0.002	
VC 0424	Cucumber	0.03	0.01	0.002	0.029
VO 0440	Egg plant	0.05	0.02	0.004	0.017
VA 0381	Garlic	0.005		0.002	0.003
VC 0425	Gherkin	0.05		0.002	0.029
MM 0814	Goat meat	W	0.01*		
ML 0814	Goat milk	W	0.005		
MO 0814	Goat, edible offal of	W	0.1		
FB 0269	Grapes	0.01		0.002	0.01
DF 0269	Dried grapes (= currants, raisins and sultanas)	0.03		0.0056	0.028
JF 0269	Grape juice	0.015		0.0028	
DH 1100	Hops, dry	0.15	0.1	0.038	
VA 0384	Leek	0.005		0.002	0.003
VL 0483	Lettuce, Leaf	W	0.05		
VL 0482	Lettuce, head	0.15		0.0275	0.097
FI 0345	Mango	0.01		0.002	0.004
VC 0046	Melons, except Watermelon	0.01	0.01*	0.002	0.002
VA 0385	Onion, Bulb	0.005		0.002	0.003
FI 0350	Papaya	0.015		0	0
FS 2001	Peaches	0.03		0.004	0.024
SO 0697	Peanut	0.005*		0	
FP 0230	Pear	W	0.02		
VO 0444	Peppers, chili, dried	0.005*	0.2	0.005	0.005
VO 0445	Peppers, sweet	0.07	0.02	0.009	0.051
FS 0014	Plums (including prunes)	0.005		0.002	0.006
FP 0009	Pome fruits	0.01		0.002	0.01
VR 0589	Potato	0.005*	0.01*	0	0
DF 5263	Raisins	0.05		0.0084	0.0224
FB 0272	Raspberry, red, black	0.002		0.002	0.03
GC 0649	Rice	0.002		0.001	
AS 0646	Rice straw	0.001		0.001	0.001
VA 0388	Shallot	0.005		0.002	0.003
VL 0502	Spinach	0.15 [a]		0.024	0.091
VC 0431	Squash, summer	W	0.01*		
FB 0275	Strawberry	0.15	0.02	0.027	0.073mi
VR 0508	Sweet potato	0.005*		0	0
VO 0448	Tomato	0.05	0.02	0.004	0.017
TN 0085	Tree nuts	0.005*		0	0

CCN	Commodity	Recommended Maximum residue level (mg/kg)		STMR or STMR-P mg/kg	HR or HR-P mg/kg
		New	Previous		
TN 0678	Walnuts	W	0.01*		
VC 0432	Watermelon	W	0.01*		
VR 0600	Yams	0.005*		0	0
OR 0691	Cotton seed oil, edible			0	

[a] On the basis of information provided to the JMPR it was concluded that the estimated short-term intake of abamectin for the consumption of spinach may present a public health concern

DIETARY RISK ASSESSMENT

The intake assessments conducted by the Meeting did not include the uses of abamectin as a veterinary drug.

Long-term intake

The International estimated daily intakes (IEDI) of abamectin based on the STMRs estimated by this Meetings for the 17 GEMS/Food regional diets were 1–5% of the maximum ADI of 0.001 mg/kg bw (see Annex 3 to the 2015 Report). The Meeting concluded that the long-term dietary intake of residues of abamectin is unlikely to present a public health concern.

Short-term intake

The ARfD for abamectin is 0.003 mg/kg bw. The International Estimated Short-Term Intake (IESTI) of abamectin for the commodities for which STMR, HR and maximum residue levels were estimated by the current Meeting. The results are shown in Annex 4 to the 2015 Report.

For spinach, the IESTI represented 140% of the ARfD for children. No alternative GAP was available. On the basis of information provided to the Meeting, it was concluded that the short-term intake of abamectin residues from the consumption of spinach may present a public health concern.

The IESTI for the other commodities considered by the Meeting represented a maximum of 70% of the ARfD, and for these commodities, the Meeting concluded that the short-term-intake of abamectin is unlikely to present a public health concern when abamectin is used in ways considered by the Meeting.

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0030401	Pointurier, R	2000b	Residue Study with Abamectin (MK 936) in or on Strawberries in France (N). Syngenta Crop Protection AG, Basel, CH ADME—Bioanalyses, Aigues-Vives, France, 0030401 GLP, not published.
9931501	Pointurier, R	2000c	Residue Study with Abamectin (MK 936) in or on Sweet Pepper in North of France. Novartis Crop Protection AG, Basel, Switzerland. ADME—Bioanalyses, Aigues-Vives, France, 9931501 GLP, not published.
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